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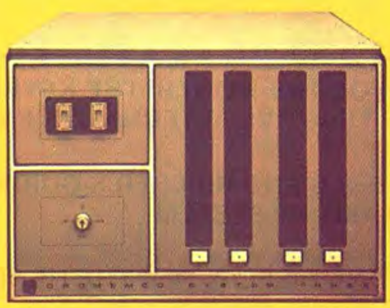

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CIRCLE INQUIRY NO. 10

VOL. 3, ISSUE 6
SINCE DECEMBER 1975

JUNE 1978

THIS MONTH'S COVER

This month's cover depicts the emergence of the microcomputer industry. From the silicon chips and sand, the integrated circuits (in the foreground) were formed.

The effect is a surrealistic dream, hinting that the industry will someday, and possibly already is as mighty and everlasting as the great pyramids.

The art is by Art Director Fino Ortiz, and photography by Margaret Fenstermaker. Materials for the cover were supplied by James Mageean of Argon Chemical and Intel Corporation.

INTERFACE AGE™

MICROCOMPUTING FOR CONSUMER AND BUSINESS APPLICATIONS

GENERAL FEATURES

BUSINESS FEATURES

HARDWARE FEATURES

SOFTWARE FEATURES

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EDITOR'S NOTEBOOK

By Carl Warren

The microcomputer industry, as we know it, is just a little over three years old. During this period microcomputing has grown from the drawing board stage, to one of the major industries in the country today.

Along with the growth, a maturing process has taken place, particularly among the publications geared to serve the field of micro- and minicomputing.

This maturing process followed the normal ebbs and flows associated with growing up. Beginning with the jealousy factor and climaxing with an unwillingness to develop a feeling of cohesiveness within the publishing field. Thank goodness the age of puberty has passed and working relationships are developing among the magazines.

Cooperation is the key to success in any endeavor, and especially important in a young, growing industry. Therefore, to further enhance this cooperative spirit, it was decided here at INTERFACE AGE, to open our pages to editors of magazines serving the microcomputer industry.

Depending upon reader reaction to this editorial conference, we hope to make this an annual affair. Possibly the idea will make its way around the industry, with each magazine providing the space on a round robin basis.

Last month I briefly discussed the different conventions that I had attended and those still to come. In relationship to conventions I would like to discuss the seminars that are usually associated with them.

Seminars are those extra things provided by promoters of conventions — usually at an extra cost to the attendee. The seminar's purpose is simple. They are designed to fill in all the gaps that books, magazines and salesmen are not always able to cover. They also make it possible for the "experts" in the field to come face to face with the public they are advising. Seminars are in themselves worthwhile and help in the education process.

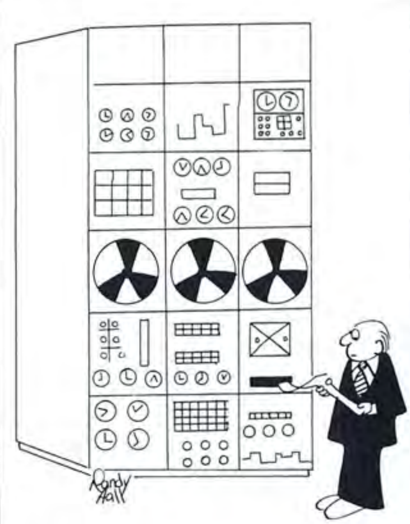
There is some difficulty with the seminar process, and that is with how the speaker is compensated for his time and expertise. In a great number of cases the total compensation is in the recognition that the forum provides for the speaker. For other seminars there is a promise of a payment to the speaker, and this is where problems tend to crop up.

When a promise of payment is made by a promoter — usually in the $200 to $300 range, it is assumed that the payment will be made either just prior to or within a reasonable length of time after the seminar. Most reputable promoters usually pay the last day of the convention. I have found that this is not always the case, and that payment may take several weeks or possibly not at all.

Therefore, what I am suggesting is that should you be asked to speak at a convention, and the promise of payment is made, get it on paper. Also, be sure that the signed statement specifies when the payment will be made. **Better yet, I heartily suggest that you get the bucks before opening your mouth.**

Recently, we have been receiving many letters and telephone calls suggesting that INTERFACE AGE is helping perpetuate a fraud, as a result of the Quasar article in the April issue.

What I want to make clear is that INTERFACE AGE does not lend credibility or support to the Quasar product line. We presented the article as a glimpse of one side of the robotics issue. Quasar claims that they are legitimate. Carnegie-Mellon University scientists have decried it as a fraud. However, until the issue is settled, possibly in the courts, INTERFACE AGE will not take either side. We leave the decision up to the readers, and those that wish to join in the fracas.



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LETTERS TO THE EDITOR

Dear Editor:

You have done a great disservice to robotics development by publishing the article on the Quasar Industries Robot. It is quite simply a fake . . .a sales promotion gimmick. . . it is not, under any stretch of the imagination, a robot. Several months ago we carried an article on this sham in our club newsletter, apparently it skipped your attention.

I have personally attended a demonstration of the "Klatu" robot, as a promotion for a local bank, and can personally attest to the fact that it is not a robot, and has no automatic control. It is, in fact, controlled by two men who stand nearby the robot and control it via radio transmission. One man generates the robot's voice by speaking into the mike of a concealed transmitter, while the other carries a small AWOL-type bag. His hand is always in the bag, obviously controlling the "robot's" movements via radio control.

Further, the machine is constructed very crudely. It's hands are nothing more than shaped wood, and perform no function other than decoration.

The machine is certainly not "a dream that came true" as is stated in the article. I feel that your magazine owes it to its readers to inform them of this hoax.

Sol Libes, President
Amateur Computer Group
of New Jersey
Scotch Plains, NJ

Dear Editor:

Thank you for the opportunity of correcting some embarrassing inaccuracies in the April article I authored on the Quasar Industries' robots. As INTERFACE AGE is aware, I wrote the article at your request under deadline pressure, sandwiched between my own heavy schedule of business activities. I relied on information from Tony Reichelt, president, Quasar Industries, in a tape-recorded, telephone interview, and drew heavily from a previous detailed interview in a "Buyer's Guide Reports" — which led me astray on the voice recognition, and so on.

Android Amusement Corp., which is completely autonomous, has been acting as the Quasar Industries' show robot booking agent only since January, 1978; my own exposure to computers has been rather limited to video game machines as a coin-op amusement operator. From the very start, we have looked upon the Quasar Industries' robot as a giant amusement machine. Thus my perspective was completely different than the majority of your readers. Also, as emphasized in the introductory remarks, my approach was light-hearted, primarily giving a behind-the-scenes look at the obviously show-biz type robot and the unusual occupation of robot technicians.

Anyhow, for the record: (1) the Sales Promotional Android (S.P.A.) has no voice recognition capabilities; (2) the S.P.A. is radio controlled. The talking is a combination of FM-radio relay and pre-recorded, 8-track tape materials; (3) there are no sensors in the base.

There has been a great deal of confusion between the Domestic Android, which Quasar Industries in New Jersey is currently developing, and the more visible, working salesman 'droid, or S.P.A. model. This has carried over to department store copywriters for advertisements, as well as the general press wanting to glamorize the S.P.A. Years ago, Reichelt began using the marketing gimmick of stating the S.P.A. has a "4800 word vocabulary." Legally, his attorneys advised him he was covered because of the tape playback capabilities and the human-assisted vocabulary. Now that technology has surpassed this stage, like almost everything in electronics, what once seemed advanced is now archaic from a technical standpoint. However, since the primary markets for the S.P.A. model continue to be department stores, trade shows, sales meetings and similar short-duration performances, radio relay remains the most practical, economical, efficient way to conduct these shows for clients.

My firm *has* deleted all references to "4800 word vocabulary" in fact sheets and advertising in the Western states.

As to allegations of "fraud" you reported receiving from some callers and readers, doubting whether Quasar Industries can produce their claimed Domestic Android, Reichelt himself was amused that your same April issue ran such articles as "A Vocal Interface for Your Robot." Even I, as a new enthusiast in this field, am fascinated by the potential of such products as Digital Group's Votrax Synthesizer. I will not comment further on Quasar Industries' Domestic Android project because I have not been East to see it yet; therefore I must reserve judgement until they have had a chance to demonstrate it to me.

I would like to express some other opinions, since I have observed as least one robot promotion being disrupted in a Los Angeles mall by university students and professors. In the few cases that have occurred so far, I feel over-zealous members of the "artificial intelligence community" may be coming closer to arrest than Reichelt.

The Dr. Dobbs' Journal, Vol. 3, Issue 2, printing a "News Release" from Stanford University showed the extreme polarity of Reichelt by exhibiting over-emotional reporting of the Quasar Industries' robots. The report tells how Carnegie-Mellon students circulated a report to colleagues at Stanford, MIT, and elsewhere, telling how four "courageous" members of the department went downtown to investigate an advertised Domestic Android by the name of Sam StruggleGear. They found a "frightening" sight in the men's department: a 5'2" image of an aerosol can on wheels, "talking animatedly to the crowd. Later these university "investigators" found a man in a blue suit with his hand held "contemplatively to his mouth" (wireless mike). At another performance, these same investigators found a "furtive-looking and rather disagreeable person loitering in the back of the room."

"He was carrying an airline flight bag with his hand stuck down in the bag." Then the report tells how the man became "very excited and called for store officials to come get us away from him."

Store officials, who are well-aware the robots are radio-controlled, have every right to remove such over-zealous crusaders attempting to disrupt their store promotions. I feel much of the motivation comes from a need for the artificial intelligence community to gain more publicity for themselves. There almost seems to be a silent cry, "Look at us, not the clown (robot). The robot is dumb; we've got the intelligence!"

I have corrected the inaccuracies, but sense the problem goes beyond that. What else do the critics want? No illusions in this world? No Artoo-Detoos? No radio-controlled robots performing in public? No more department store Santas at Christmas time?

I do not recall the Star Wars movie opening with any great announcement that little Artoo-Detoo was operated by midget Kenny Baker inside. In fact, I'd bet many of your own readers learned that only after reading John Stears' fascinating article in the April issue on how he built the Star Wars' robots.

Do the critics that spend time attacking Quasar Industries also plan to picket George Lucas, Stears, and 20th Century Fox?

I hope not, because I — and a lot of others on this Earth — still love such illusions. The Quasar Industries' robots have entertained literally hundreds of thousands of people worldwide; I can attest to seeing people of all ages laughing and thoroughly enjoying this space-age "magic act." Also, it is serving as the public relations forerunner of more serious robots to come. Thus, in time, the marketing effects will benefit the artificial intelligence community. The Quasar Industries' robots and the Star Wars robots have created a desire that borders on love for the mechanical, moving machines. Such demand in the marketplace will benefit even university researchers relying on government grants.

If there are any critics left, I can only encourage: rather than protest, create. If you can produce better robots that will survive the grueling work of daily performances up to 8

hours a day, and add more impressive technical improvements to sell the clients and impress the public, Android Amustment Corp. will be happy to act as your robotic talent agent!

Gene Beley, President
Android Amusement Corp.
Arcadia, CA

Dear Editor:

I have enclosed supportive documentation in rebuttal to Pat Staken's letter to the editor which appeared in the March 1978 issue. I have confirmed the fact that Goble's article was correct the way it was printed. Pin 35 is DO-1 and pin 88 is DO-2.

Frank W. Gregorio
E&L Instruments, Inc.
Derby, CT

E&L went to a great deal of trouble verifying the pin numbers, through various sources. Therefore, we can say with a great deal of certainty that Goble's article is correct. We do apologize for answering Mr. Staken's letter so quickly, without verification on our part.

Dear Editor:

In the March 1978 issue of INTERFACE AGE there is a letter to the editor from Pat Staken, Greenbelt, MD. In this letter he states that several errors exist in my article on the S100 appearing in the June 1977 issue.

This seemed very strange to me since several p.c. boards have been designed and built to these pinouts. I checked with six different sources and found the article to be 100% CORRECT.

I hope nobody reads the letter and gets confused.

William M. Goble
Southampton, PA

Bill, hopefully they will now read your letter and get unconfused.

Dear Editor:

In reply to your letter of March 28, 1978, I will document my allegations as to the problems with the finance program in the March issue. In no way would anyone with any competence in programming have overlooked some of these errors.

I will include a list of corrections for you to publish so that others will be able to use this program. The corrections will enable it to be run on most 8K or larger BASICs. If I were you I would look most carefully into my so-called evaluator's competence.

Enough for the criticism, in the past you havé published some very useful programs and games which I have enjoyed. The report writer was a real jewel and with a little substitution of the words it writes almost believable reports. I consider your publication the best in the business. That is why I was so disappointed with the finance program.

Now here are the corrections by line number:

```
 420 PRINT: PRINT: PRINT
 490 IF K1 = 2 THEN 2370
 610 DEF FNB(X,Y,Z)=INT(1/((1+Z/C5/100)^(Y*C5))
     *X*100+.5)/100
 900 X8 = 1/X7^A
1020 GOSUB 810
1060 A=LOG(X)/LOG(X7)
1520 P=(1-1/(1+B/100)^(A))/(B/100)*C
1580 P1 = 1/(1+B/100)^(A)*E
1770 GOTO 1500
DELETE 1780 TO 1810
1980 PRINT "THE BALLOON PAYMENT = ";FNA(E)
2200 02 = C - 03
2250 PRINT I,FNA(02),FNA(03),FNA(04),FNA(05)
2390 G = G/C5
2400 PRINT: PRINT
2540 PRINT: PRINT: PRINT
2560 PRINT: PRINT: PRINT: PRINT
```

I do hope that I got all of the errors.

Clifford G. Soderback
Portland, OR

We appreciate your "fixes," but can only say the original ran on our machine.

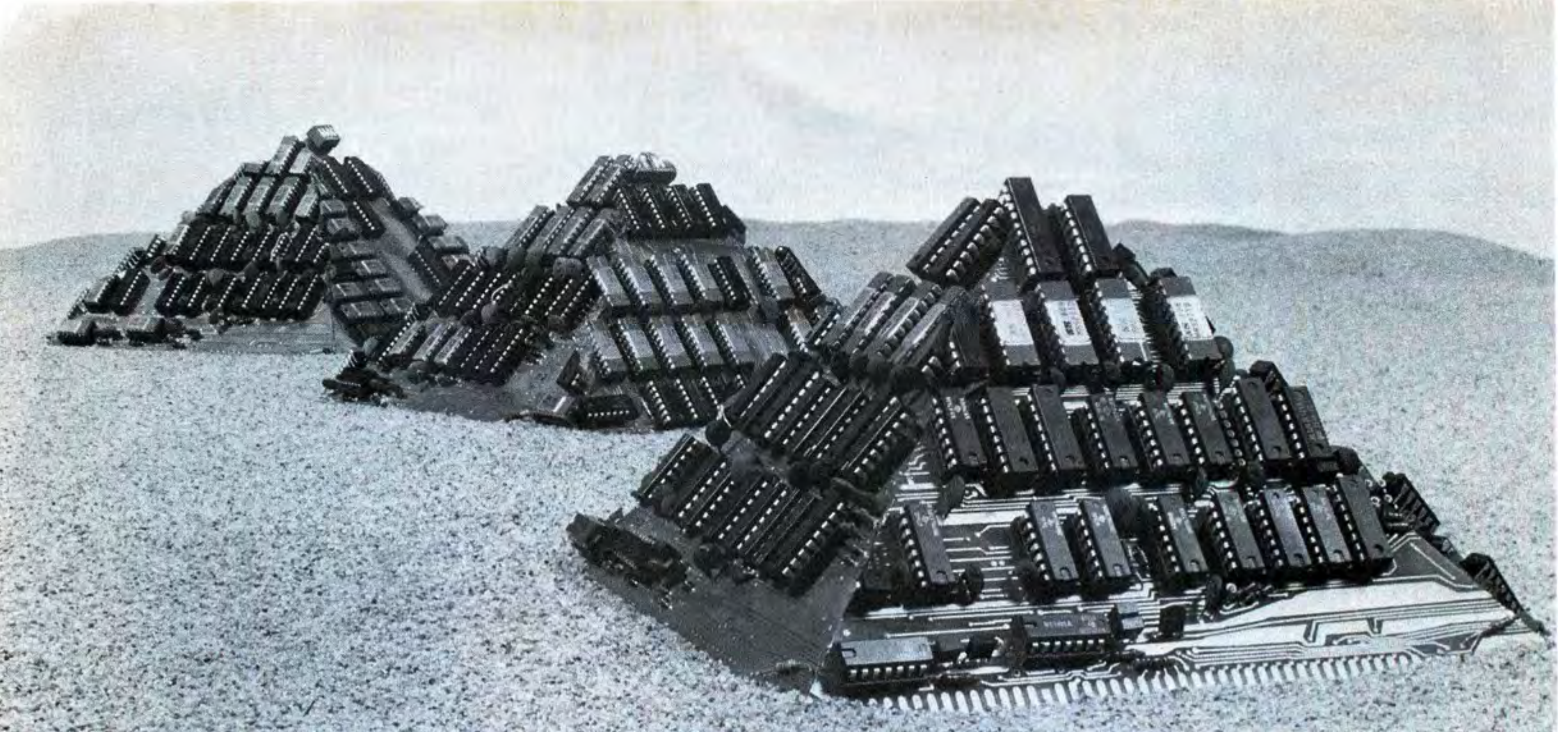
Dear Editor:

In a February, 1978 article Frederick La Plante, Jr. presents a definition of random files that is at odds with the established usage of that term. What he really is describing in his "Random Files Illustrated" article is one type of use of Indexed Sequential Files (known to big computer users as ISAM files — Indexed Sequential Access Method).

A brief comparison of true random access files and indexed sequential files is as follows:

Terminology

A file is composed of records. Each record is composed of a look-up key (e.g. Social Security Number or other unique identifier), and related information fields. It is presumed



Now Dynabyte builds three Great Memories

New! 16k and 32k fully static RAM's. With either 250 ns. or 450 ns. typical access time. Assembled. Tested. Burned in. Guaranteed. Like our 16k dynamic RAM. Built as solid as the 4,400 year-old pyramids.

Ancient Egyptians didn't stop with just one pyramid. The Great Pyramid stands on the Plain of Gizeh with two other monuments erected for kings and queens.

Dynabyte didn't stop with one 16k dynamic RAM, either. Now you can get 16k and 32k fully static RAM's that are built with the same unmatched engineering ability and manufacturing skill that went into Egypt's wonders of the ancient world.

When we say built, we mean completely built. Assembled, tested and burned in. We don't leave anything undone. That way, you can buy any Dynabyte memory and know that it is backed by a factory guarantee for one full year. Kits and semi-kits can't say that.

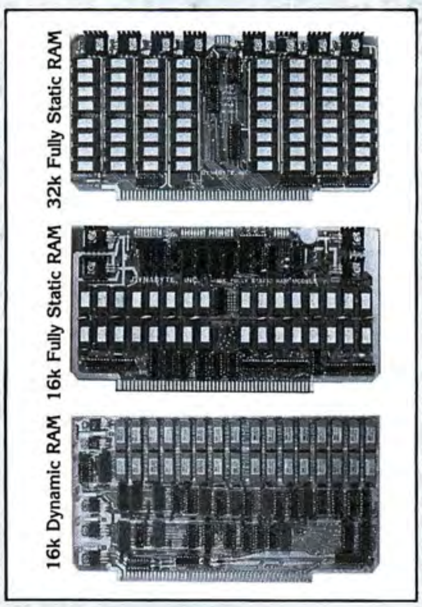
Our 16k static and our 32k static are available with either 250 ns. or 450 ns. access time. Our 250 ns. module is completely compatible with the 4MHz Z-80A processors. The 450 ns. modules are compatible with the 8080 and the faster 3MHz 8085 processors.

The Great 16k Static Memory. 250 ns., $555. 450 ns., $525.

- 4k block addressing along 4k boundaries
- Bank Select
- Write Protect with alarm for each 4k block
- Full Schmitt trigger buffering
- No DMA restrictions
- Complete S-100 bus compatibility, including the Alpha Micro and Z-2.

The Great 32K Static Memory. 250 ns., $995. 450 ns., $925.

- 4k boundary addressing
- Full Schmitt trigger buffering
- No DMA restrictions



- Conservative thermal design
- Complete S-100 compatibility, including the Alpha Micro and Z-2.

The Great 16k Dynamic Memory. $399.

- Highly cost effective
- No wait states
- Transparent refresh
- 16k addressing boundaries
- Widest S-100 mainframe and disk system compatibility

All of Dynabyte's memories meet rigid industrial grade standards. Design, components, construction, testing and performance. But if a module ever needs repair, we provide factory service with 24 hour turnaround for both warranty and non-warranty work.

Ask for the Great Memories by Dynabyte at your local computer store. You can also pick up complete product information while you're there.

If you haven't got a local computer store, write Dynabyte, Inc., at its new address: 1005 Elwell Court, Palo Alto, CA 94303. Or call its new number (408) 965-1010.

DYNABYTE

Builders of Great Memories

that the size of the key is small in relation to the total record size.

Ideally, given a key for a desired record, we should be able to find the record with only one physical disk read. The worst case is the orginary sequential file where on the average we must be physically read half of the file to find any one record!

Indexed Sequential

As described in Mr. La Plante's article, an Indexed Sequential file stores records sequentially, but an in-core table is kept of the keys. This table can be searched very rapidly to find the disk location of the desired record. A single physical disk reads then retrieves it.

Random Access

The central concept of Random Access is that the disk storage address can be calculated from the key itself by a fixed algorithm. A large range of potential keys is "mapped" by this process into a finite set of real disk addresses.

Some reflection upon the size of the potential "key-space" (i.e., 9-digit Social Security numbers) versus the disk address space (say, 1M bytes), leads one to several conclusions:

1) The mapping of "key-space" to disk-space cannot be one-to-one. Hence, there will be cases where more than one key yields the same disk address.
2) The disk space will not be completely used in most cases. The records will not be contiguous within the file.

The first case is the famous "collision" problem. Many schemes exist to handle this condition. The second point defines the "leading factor" of a random access file — the percentage of storage space actually used to hold records.

The interested reader is urged to reference Donald Knuth's *The Art of Computer Programming, Volume 3, Searching and Sorting* for a complete treatment of this topic.

Let me whet your appetite by noting that the "bucket-hashing" method of random access seems ideally suited for the relatively small disk storage units available to most microcomputers.

In summary, a true random access file system has these two properties:

1) The storage address is calculated from the key itself.
2) Records are not stored contiguously in the file. Indeed, as one might suspect by now, the storage address calculation ("hashing") is used to initially store the record as well as for its later retrieval.

Tom Slezak
Pleasant Hill, CA

Tom, we appreciate your comments and consequently are running your letter in total.

50,000TH LSI TERMINAL DESTINED FOR BOOMING EUROPEAN MARKET

In a special presentation on the plant floor witnessed by the entire production staff and management, Lee Falco, general manager of Lear Siegler's Data Products Group, personally delivered the company's 50,000th video display terminal — an ADM-3A Dumb Terminal™ — to a major European customer.

The latest computer terminal to come off the company's assembly line was handed to Bruce Woodall, chief executive officer of Teleprint GMBH, Frankfurt, the largest independent distributor of computers and computer peripheral hardware in Germany, Belgium and Holland.

Woodall noted that the Lear Siegler ADM-3A Dumb Terminal is "the best known computer terminal currently available on the European market," and that this device and others like it have become increasingly important factors in the market as more and more users move away from one-supplier systems.

"Following trends in the United States," he said, "European computer users are becoming far more sophisticated, taking advantage of the many performance and cost improvements possible by mixing system components."

He also noted that low-cost, high-performance hardware such as the ADM-3A Dumb Terminal is making computer power available on a large scale to first-time users in Germany and other countries.

"As in the United States," he commented, "distributed data processing has become a major force in the hardware marketplace."

Typical of this type of application, he went on, is a non-profit German organization of tax consultants.

"By setting up a data base and providing easy access to it via Lear Siegler display systems," he explained, "more than 5,000 accountants who normally would not have access to this type of information can now easily get it in real time."

Another example of this type of system, he continued, is one designed and set up by Lufthansa, Germany's international airlne, to combat terrorism.

"In this case," he went on, "the terminals are used to verify that passengers who check luggage on board a flight actually board the flight. The terminals they've installed truly help make the best of what is, under the best of conditions, a difficult situation."

In applications such as these, Teleprint, a wholly-owned subsidiary of Mannesman A.G., the tenth largest company in Germany, not only supplies the terminals, but also designs and integrates the control logic needed to interface the hardware to IBM and other mainframe processors.

Woodall estimates that terminals designed for interfacing to mainframe processors and for distributed data processing systems account for over 70 percent of the terminal business in Germany, and, he says, "this market is growing very fast — in the neighborhood of 35 to 40 percent per year, compounded." Traditional asynchronous terminal applications make up the remaining 30 percent of the terminal market, he said.

Expanding applications in Europe are not the only reasons for the booming market for American computer hardware, according to Woodall. The continuing increase in the value of the Mark as opposed to the dollar is making imported American systems extremely attractive. "In 1971, for example," he pointed out, "a video terminal of this type went for 10,000 Marks. Today they sell for 5,000 Marks, and have twice the power."

SS-50 BUS MANUFACTURERS MET AT 2ND COMPUTER FAIRE

All manufacturers of SS-50 bus compatible hardware met together at the second Computer Faire in San Jose to discuss possible new bus signal assignments. Represented at the meeting were Southwest Technical Products Corp., Midwest Scientific Instruments, Smoke Signal Broadcasting, Gimix and The Micro Works.

It was agreed that uniformity of use was essential to protect current and future users of the bus from the incompatibility and general chaos now being faced by S-100 users and manufacturers. It was agreed by everyone present that any revised, or additional bus line assignments would be cleared with all concerned before being designed into equipment. A suggestion to change the present "Phase 1" line to "Slow Memory" was made by Mr. Childress of Midwest Scientific Instruments. Several others present agreed that this was a reasonable change, since "Phase 1" was a redundant signal that could be obtained by inverting "Phase 2" which is also present on the bus. If no objections are found, this change will be considered for action by all manufacturers of the SS-50 bus to make the change official.

A discussion of possible additions, or changes, to the bus system for MC-6809 processors brought up the subject of monitor and software compatibility in these machines. It was agreed that Mr. Dave Shirk of Technical Systems Consultants Inc. would be asked to recommend jump table addresses that would be used by all SS-50 manufacturers in these systems. This would insure that all users of this advanced processor on the SS-50 bus would be able to interchange hardware and software easily between monitors written by different sources.

Mr. Robert Lenz, president of The Micro Works, reported that he had conducted some experiments with high speed processors and that he had found that no problems with cross talk, or any need for terminations, etc., at speeds up to 3.0MHz with a standard SS-50 bus.

The next meeting of the SS-50 manufacturers association will be held at Personal Computing '78, in Philadelphia. All manufacturers of SS-50 bus compatible products are invited. All users of the bus are also invited to participate in the meeting and to send any suggestions they may have to any of the above manufacturers for consideration at this meeting.

SMALLER COMPUTERS SEEN ASSUMING ROLE OF LARGER SYSTEMS

Ryal R. Poppa, Chairman of the Board, President and Chief Executive Officer of Pertec Computer Corporation (PCC), told an audience at the Financial Analysts Federation Symposium on High Technology, that the very small business systems segment is assuming the role of growth-leader in the computer industry. Small businesses today are finding they can buy more computing power for less money — and operate them for less, also — than they ever could with larger systems.

"This acceptance of microcomputers — more popularly known as personal computers — is expected to take this part of the computer industry from a projected sales level this year of $398 million to 1983 sales rates of more than $1 billion, largely on the strength of affordability to the small businessman," he said.

Mr. Poppa spoke during an after-

noon panel on "The Computer Industry — Emerging Markets for Microprocessors, Microcomputers, Small Business Computers and the Home Computers." PCC, through the MITS/Altair™ and iCOM® product lines is a pioneer in the development and marketing of very small computer systems that are "computerizing" businesses previously considered "too small" for data processing.

"Almost all of the products are sold through retail stores that are independently owned by entrepreneurs in their own right," Mr. Poppa told the financial analysts.

"Most of the technology to meet the needs of the corner drug store, regional hardware chain or cotton gin farmers is already in place — or ready to be introduced," Mr. Poppa said. "Intelligence on a semiconductor chip and low-priced peripherals are available. Complete systems are being built into desks and by year-end there will be even further reductions in system size, giving even more for less.

"The price of such a computer, including the vital software to make it run, is around $15,000 for the average installation today. But that price is declining and the $10,000 system should be common in 1979," he projected.

"Software requirements — those vital instructions written to make a computer serve the specific needs of users — are also ready. Since 1975, some 20,000 MITS/Altair systems have been sold and put into operation. Those buyers — many of them home hobbyists — did some original software programming and are now making it available to end-users and manufacturers."

HAROLD HAYNES TO ASSESS NATIONAL ENERGY PROBLEM AT 1978 NATIONAL COMPUTER CONFERENCE

Harold J. Haynes, chairman of the board and chief executive officer of Standard Oil Company of California, will delivery a major keynoting address on Tuesday, June 6 at the 1978 National Computer conference in Anaheim, California. Haynes' address, which will include an analysis of current energy problems, will be the feature of the Conference Industry Luncheon to be held in the Anaheim Room of the Anaheim Convention Center. This year's NCC, the largest gathering of the computing and information processing field, is expected to draw up to 40,000 attendees from the computing field, major user industries, the business and financial community, government, education, plus related professions and disciplines.

He is expected to comment upon a major theme of this year's NCC — the present and potential role of computers in helping to alleviate the world energy problem. He will also assess the current energy situation and describe proposed solutions by industry.

Haynes, a graduate engineer and a director of the American Petroleum Institute, will comment on energy needs and priorities both in terms of our national interest and the worldwide supply and demand picture. Included will be discussion of various approaches to the more efficient utilization of existing energy resources, plus those efforts now on the drawing boards related to the development of new energy resources and techniques for their optimum utilization.

A MAJOR CONVENTION FOR PERSONAL & BUSINESS COMPUTING

Personal Computing '78™ will move to a new location for this year's presentation when the Philadelphia Civic Center plays host to the most complete display of personal computing exhibits east of the Rockies. The 1978 presentation will run four days, August 24-27, making it the largest show of its type anywhere.

The opening session of the show will feature a full-day industry trade show set aside for dealers and members of the industry as well as guests of exhibitors and representatives of TV and other segments of the media. Special meetings and seminars for dealers and retailers are planned for the opening night at the convention headquarters hotel in the Philadelphia Sheraton.

In addition to the exhibits, other attractions will include an art show, music festival, computerized mouse maze, and the highly successful Personal Computing College™. The college will again include over 80 hours of free in-depth seminars conducted by some of the country's leading names in the computing field. There will be topics of interest for everyone, whether the individual is a beginner, student, hobbyist, educator or computer professional. Several sessions will be tailored to the needs of businesses which have seen the tremendous advantages of micro and minicomputer processor applications.

Professional seminars featuring in-depth study will again be conducted during the week by companies such as Adam Osborne and Associates, Sybex and Tychon, Inc. at the nearby Hilton Hotel.

For information contact Personal Computing '78, John H. Dilks III, Rt. 1, Box 242, Warf Rd., Mays Landing, NJ 08330, (609) 653-1188.

INTERFACE AGE ALERTS READERS

In the April 1978 issue, on page 127 the advertisement for the Byte Shops of South Florida, has two printed errors. The first one is, the phone number for the Byte Shop of Miami is incorrect and should be

DIAL (305) 264-BYTE. The second error is on the Byte Shop of Fort Lauderdale, the printer left off the phone number which should be

DIAL (305) 561-BYTE. So readers be sure to correct your phone listing and give them a call to let them know that you got the message.

THE SOUTHERN CALIFORNIA SWAP MEET

Just an old-fashioned, good-time swap meet for computer hobbyists, hams and electronic experimenters. People will be coming from as far south as San Diego. . .as far north as San Francisco. . .and as far east as Phoenix! Time: July 1st, 1978 from 9 AM to 4:30 PM. Place: The Salvation Army Community Center, 4849 Hollister Avenue, Santa Barbara. Admission free to buyers. Sellers contact John Craig, RFD Box 100D, Lompoc, CA 93436 for more information, or phone (805) 735-1023. Y'all come!

NEW IDC PORTRAIT OF SATELLITE BUSINESS SYSTEMS

International Data Corporation, the leading market research and analysis firm devoted exclusively to the computer industry, has just released a new report on Satellite Business Systems (SBS). This report offers insight into the IBM-COMSAT-AETNA subsidiary that could potentially revolutionize corporate communications in the 1980s. Some examples:

- Covert benefits to IBM will not be a problem. The separation restrictions imposed by the FCC are fairly strict and are being adhered to. Even the Computer and Communications Industry Association, one of the opponents of IBM's entry into the DOMSAT arena, has voiced satisfaction with the FCC's safeguards.

- The innovative satellite system will originally support a digital bit rate of 430 Mbps, but by merely adding one more satellite (the ground spare) SBS could double that by revising backup algorithms.

- The SBS filing with the FCC stops at 375 earth stations in projections of earth stations to be installed (the saturation point for the intial system). But alternative analysis show how that could be over 500 with no extra satellites, over 1,000 just by launching the ground spare.

- Although voice traffic will predominate on the SBS system, the strength of its success will depend on new applications. SBS, for instance, has already chronicled the evolution of today's existing facsimile, word processor, and copier systems into tomorrow's *electronic mail* systems. In addition, layouts for centers of *teleconferencing,* a concept SBS is pushing especially hard, have been proposed by SBS spokesmen.

- Project Prelude experiments, attended by IDC personnel, provide some initial insights into the viability of those new applications. They also illustrate some of the roadblocks. Teleconferencing will supposedly allow impromptu meetings to take place at a fraction of the cost of regular conferences. . .but how imprompty can they really be? Who controls the teleconferencing resources? How are overuse and abuse prevented?

- SBS recovery of system costs doesn't require a huge market share, and the company is offering conservative projections of what that share will be. Some of the reasons for conservatism include the other satellite carriers (estimated by IDC to have 1977 revenues around $50 million) and, perhaps more imporantly, AT&T terrestrial systems. Finally, despite the current low usage of the SBS frequency bands, there *are* limitations. New generations of satellite systems are already in design.

This Special Report, researched and written as part of IDC's *Distributed Processing Reporting Service* — but offered separately — is both a reference document and analysis of SBS, its system, and its implications. The informatino was compiled through personal interviews, SBS documents and presentations, and independent sources. It's price for non-subscribers to the DPRS is $90.

CALCOMP TO END MAINTENANCE CONTRACTS ON SELECTED OUT-OF-PRODUCTION PRODUCTS

California Computer Products, inc. (CalComp) has announced plans to end contract maintenance and software support by April 1, 1979, on selected graphics products which have been out of production for several years.

In making the announcement, James F. Waltz, vice president, sales for the Graphics Products Division, said this is the first time CalComp has phased out support of products it manufactured.

"Training field engineers to maintain out-dated equipment has become prohibitive from the standpoint of cost and time," said Waltz. "Replacement parts are out of production and becoming scarce in some cases. Software training and support by field systems analysts is equally prohibitive."

Products affected by the new policy are: controller models 210, 211, 470, 570, 580, 900, 910, 937, the 700 series, and 11x series controllers; drum plotter models 1136, 663, 665, 763, and 765; flatbed plotter

models 618, 718, 728, and 738; and computer output microfilm model 835.

According to Waltz, these products will be serviced by CalComp on an on-call, best effort basis only; the company will be available for servicing machines if a trained field engineer and/or systems analyst is in the area.

"We are notifying our customers directly of the new policy," said Waltz. "We hope that by giving a full year notification, there will be plenty of time to make a transition. Of course, our field staff will be working individually with customers to help them make other arrangements for maintenance of these CalComp products."

In addition to graphics products, CalComp markets a broad line of other computer peripherals including disk memory products, automated tape library systems and IBM plug-compatible memory products.

APPLE COMPUTER, INC. DISCLOSES EQUITY FINANCING FROM MAJOR INVESTMENT FIRMS

Apple Computer, Inc. has obtained funding through a recent equity offering. The investors include Venrock Associates, Capital Management, Inc., and Arthur Rock, three highly respected names in the venture capital community.

Initial financing for the company was provided by the Bank of America and by individuals within the company.

A.C. Markkula, Apple's board chairman, said "The proceeds will be added to our working capital and used to increase the company's production, new product development and worldwide marketing programs."

"Apple currently enjoys a 12-month market and technology leadership position, and we intend to maintain it."

"We expect Texas Instruments and Atari to enter our market within the next 18 months," Markkula said.

Apple Computer, Inc. has been in the personal computing business since January, 1976, and has been shipping the Apple Computer since May of 1977.

AM-100 USERS GROUP FORMING

A program exchange and newsletter is being established for users, owners, and persons interested in the Alpha Micro Systems AM-100 computer system.

The newsletter will be issued monthly. It will contain descriptions of the programs that have been submitted by users. In addition, it is planned to include in the newsletter short announcements of programs that are in the process of being developed as well as other items of interest. The newsletter will be mailed first class.

The distribution medium of the programs and their support files will be via floppy diskettes written in the IBM compatible AMOS™ format.

For further information concerning membership and details of program submission, please contact Lefford F. Lowden, 616 Long Pond Road, Rochester, NY 14612.

USERS GROUP BEING FORMED

Attention Digital Group system owners: You are not alone! There are others out there who would like to share their joys and sorrows with you.

An independent users group is being formed to act as a clearing house for exchange of information. The first issue of the newsletter features an evaluation of Micro-Com software, an interface to a selectric (hardware and software), a discussion of the problems in expanding past 26K, a flea market section, and much more.

For information, write to: Lloyd Kishinsky, DG Users Group, P.O. Box 316, Woodmere, NY 11598.

CIRCLE INQUIRY NO. 18

July 1 Louisville Area Computer Club (LACE) will meet at the University of Louisville, Speed School Auditorium at 1 P.M. For details, write the club at 115 Edgemont Dr., New Alban, IN 47150.

July 1 The Computer Hobbyist Group will meet at 1 P.M. in the Green Center, Rm 2.530, of Univ. of Texas, Dallas. For details write to P.O. Box 11344, Grand Prairie, TX 75051.

July 1 South Central Kansas Amateur Computer Association, 9:00 A.M., Wichita Public Library, Wichita, KS. For further information call Chris Borger at (316) 265-1120 or Dave Rawson, 1825 Gary, Wichita, KS 67219, (316) 744-1629 for further details.

July 1 Oklahoma Computer Club will be meeting at the Belle Aisle Library at 10 A.M. Call Al Campbell at (405) 842-4933 for details.

July 1 Milwaukee Area Computer Club will meet at 1 P.M. at the Waukesha County Technical Institute, New Berlin, WI. Call (414) 246-6634 for further details.

July 1 Southern Nevada Personal Computing Society will meet at Clark County Community College, Las Vegas, NV at 12:00. The club also meets on the 3rd Saturday of the month. For further information write SNPCS, 1405 Lucille St., Las Vegas, NV 89101 or call (702) 642-0212.

July 3 Minnesota Computer Society will meet at the Brown Institute, Room 51, 3123 E. Lake Street, Minneapolis, MN. For further information contact the Society at Box 35317, Minneapolis, MN 55435, Attn: Jean Rice.

July 4 Tidewater Computer Club will meet at the Electronics Computer Programming Institute, Janaf Office Bldg., Janaf Shopping Center in Norfolk. The club also meets on the 3rd Tuesday of the month. For details contact: C. Dawson Yeomans, Interface Chairman, 677 Lord Dunmore Dr., Virginia Beach, VA 23462.

July 5 New England Computer Society will meet in the cafeteria of the MITRE Corp. at 7:00 P.M. Located on Route 62 in Bedford, MA. Contact Dave Day at (603) 434-4239 for details.

July 5 Kitchener Waterloo Microcomputer Club will meet at the University of Waterloo, Room 3388, Engineering Bldg. #4, University Ave., Waterloo, Ontario, Canada at 7:30 P.M.

July 5 The Valley Computer Club will meet at 7 P.M. at the Harvard School located at 3700 Coldwater Canyon, Studio City, CA.

July 5 Columbus Computer Club will meet at the Center of Science and Industry at 7:30 P.M. For further information write c/o Fred Hatfield K8VDU, Computer Data Systems, 1372 Grandview Ave., Columbus, OH 43212, or call (614) 488-3347.

July 5 Lincoln Computer Club will hold its meeting at the South Branch Library located on 27th and South Sts. at 7 P.M. For more details write Hubert Paulson, Jr., 422 Dale Dr., Lincoln, NE 68510.

July 6 Microcomputer Users Group (MCG) will hold its meeting at the University of Minnesota, Electrical Eng. Rm. 115 at 7 P.M. The club meets every Thursday. For more information write MCG, Dept. of Elec. Eng., 123 Church St. S.E., Minneapolis, MN 55455.

July 6 Bay Area Microprocessors Users Group (BAMUG) will meet in the Hayward ROC Center, 26316 Hesperian Blvd., Hayward, CA at 7:30 P.M. For further details write BAMUG, 1211 Santa Clara Avenue, Alameda, CA 94501.

July 6 Northwest Computer Society meets in the Pacific Science Center in Seattle, Room 200 at 7:30 P.M. For more details write NCCN, Box 242, Renton, WA 98055.

July 7 Microcomputer Information Group will meet at 7 P.M. at the Microcomputer Resource Center, 5150 Anton Dr., Rm. 212, Madison, WI 53719, (608) 274-8925. Len Lindsay, president.

July 7 Crescent City Computer Club will hold its meeting at the University of New Orleans, Lakefront Campus at 8 P.M. Call Bob Latham at (504) 722-6321 for more details.

July 8 The Permian Basin Computer Group — Odessa Chapter meets at 1 P.M. in the Electronic Technology Bldg., Room 203 on the Odessa College campus. For details call (915) 332-9151.

July 9 North Orange County Computer Club will have its meeting at Chapman College, Orange, CA. Doors open at 12:00. 105 Hashinger Hall Auditorium. Membership Chairman, Tracey Lerocker, (714) 998-8080 evenings. For more information write P.O. Box 3603, Orange, CA 92655.

July 12 Home Computers Users Group for Radio Shack TRS-80 meets at 7:30 PM. For details write or call TRS-80 Users Group Information of Eastern Massachusetts, c/o Miller, 61 Lake Shore Road, Natick, MA 01760, (617) 653-6136.

July 13 Mid America Computer Hobbyist meeting will be at 7:00 P.M. at Commercial Federal Savings & Loan, Bellevue NE. Intersection of Galvin Rd. and U.S. Hwy. 73-75. Write P.O. Box 13303, Omaha, NE 68113 for further information.

July 13 Utah Computer Association will meet at Murray High School, Rm 154, 5440 S. State St., Salt Lake City, UT at 7 P.M. For details write or call Larry or Holly Barney, 1928 S. 2600 E., Salt Lake City, UT 84108. (801) 485-3476.

July 13 The Rochester Area Microcomputer Society will meet at the RIT Campus, Rm. 1030, Bldg. 9 at 7:30 P.M. For details write RAMS, P.O. Box D, Rochester, NY 14609.

July 13 North Florida Computer Society will meet at 227 Edison Dr., Pensacola, FL 32505. For details write this address or call Eugene Rhodes at (904) 453-3844.

July 14 HAUCC will meet at 7:30 PM in Rm 117 of the Science & Research Bldg. of the main campus of the Univ. of Houston. For more details write or call P.O. Box 37201, Houston, TX 77036, (713) 661-6806.

July 14 Northern New Jersey Amateur Computer Club (NNJACC) will hold its meeting at the Fairleigh Dickenson University, on the Rutherford Campus, Becton Hall, Room B8, at 7 P.M. For details write NNJACC, 593 New York Ave., Lyndhurst, NJ 07071.

July 14 Homebrew Computer Club meeting will begin at 7 P.M. in Menlo Park, CA at the Stanford Linear Accelerator Center Auditorium. Call (415) 967-6754 for more details.

July 15 San Diego Computer Society will meet at the Grossmont Community College Student Center, 8800 Grossmont College Dr., El Cajon, CA. Doors open at 12:30. For details call (714) 565-1738.

July 15 The 7C's Committee (Affiliated with the Cleveland Digital Group) will meet at Cleveland State University Student Services Bldg., in the Kiva Room at 2:00 P.M. For more information write to Cleveland Digital Group, 8700 Harvard Ave., Cleveland, OH 44105.

July 15 Philadelphia Area Computer Society will meet at 2 PM at LaSalle College Science Bldg. at the corner of 20th & Olney Ave. For more details write PACS, P.O. Box 1954, Philadelphia, PA 19105.

July 15 Computer Hobbyist Group of North Texas will meet at UTA University Hall, Rm 108 at 1 PM in Arlington, TX. For details call Neil Ferguson at (817) or (214) 265-9054.

July 16 Central Florida Computer Club will meet at 2010 Fosgate Dr., Winter Park, FL 32789 2:00 PM. Contact Bill Kerns for details.

July 16 Chicago Area Computer Hobbyist Exchange (CACHE) will meet at 1 PM in the Northern Illinois Gas Bldg., Golf and Sherman Rds., Glenview, IL. For details write CACHE, P.O. Box 52, So. Holland, IL 60473, or call CACHE Hotline, (312) 849-1132.

July 18 Rhode Island Computer Hobbyists (RICH) meets the at the Knight Campus of Rhode Island Junior College in the Faculty Cafeteria at 7:30 P.M. For details contact Emilio Iannucillo,

RICH, P.O. Box 559, Bristol, RI 02809, or call (401) 253-5450.

July 20 Long Island Computer Association meets at 7 PM at the New York Institute of Technology, Old Westbury Campus, Route 25A between Route 107 and Glen Cove Rd., Rm. 508. For more details write Long Island Computer Association, 36 Irene Lane East, Plainview, NY 11803.

July 20 Amateur Computer Group of New Jersey (ACGNJ) meets at UCTI, 1776 Raritan Rd., Scotch Plains, NJ 07076 at 7 P.M. For further information write to the club at the above address.

July 20 Madison Computer Society will meet at 7:30 P.M. at 2707 McDivitt Rd., Madison, WI 53713. Mike Shoh, president.

July 23 Summit City Computer Club will meet at the McMillen Library on the Indiana Institute of Technology Campus in Ft. Wayne, IN. For details write the club at P.O. Box 5096, Ft. Wayne, IN 46805.

July 23 Birmingham Microprocessor Group will meet at Southcentral Bell Company headquarters bldg. at 2 P.M. For further details write or call Jim Anderson, 2931 Balmoral Rd., Birmingham, AL 35223; (205) 897-9630.

July 25 Sacramento Microcomputer Users Group, (SMUG), 7:30-9:30 P.M. at SMUD Training Bldg., on 59 St. Write Richard Lerseth, P.O. Box 161513 or call (916) 381-0335 after 5:00 P.M.

July 25 Computer Amateurs of So. Jersey will holds its meeting at the National Park Municipal Bldg., 7 So. Grove Ave., National Park, NJ at 7:30 P.M. For details call (609) 541-1010, or (609) 541-8296.

July 26 Diablo Professional Users Group (DPUG) will meet at Diablo Valley College Library, near the Willow Pass exit of Fwy. 680, from 8-10 PM. For details write or call Bob Hendrickson, Electronics Dept., DVC, Pleasant Hill, CA 94523; (415) 687-8373.

July 26 Boston Computer Society will meet at the Commonwealth School, 151 Commonwealth Ave., Boston at 7 P.M. The school is located on the corner of Dartmouth St. in Boston's Back Bay. For information write or call the society at 17 Chestnut St., Boston, MA 02108, (617) 227-1399.

July 26 Ventura County Computer Society will meet at Camarillo Public Library, 3100 Ponderosa Dr., Port Hueneme, CA 93041 at 7:30 P.M. For more information write: VCCS, P.O. Box 525, Port Hueneme, CA 93041.

July 27 Space Coast Microcomputer Club will meet at 7:30 PM at the Merritt Island Library, Merritt Is., FL. Contact Ray Lockwood at (305) 452-2159 for details.

July 27 Small Computer Engineering Association of Minnesota (SCEAM) will meet at the Resource Access Center, 3010 Fourth Ave. So., Minneapolis, MN 55408 at 7 P.M. For more information write to this address or call (612) 824-6406.

July 28 Washington Amateur Computer Society has scheduled its meeting to be held at the Catholic University of America, St. Johns Hall. Located at Michigan and Harewood Aves. in Washington, D.C. Contact Bill Stewart at (202) 722-0210 for club details between the hours of 10 A.M. and 12 P.M.

July 28 Alamo Computer Enthusiast meets at 7:30 PM in Rm 104 at Chapman Graduate Center at Trinity University, San Antonio, TX. For details call (512) 532-2340, or write to the club at 7517 Jonquill, San Antonio, TX 78233.

NOTE: There has been a change of policy regarding the Calendar section.

*Beginning with the September issue, club meeting dates will not be considered for inclusion in the Calendar unless a separate notification, by letter, is received for **each** month of publication.*

*Notification must be received by the 1st of the month, **three** months prior to the event; i.e., meeting dates for September must be received by June 1 to be published in August.*

"A penny for your thoughts!"

WHITE COLLAR MICROCOMPUTER

By James S. White

Computer stores come in many flavors. Microcomputer retailers are not all the same, often for reasons much deeper than the widely varied products that they sell. These facts are obvious to anyone who has had meaningful dealings with several stores.

However, this diversity may be a real surprise to the prospective business user first venturing into the world of microcomputers and their retailers. A recent article in COMPUTERWORLD, by displaying similar ignorance, showed how widespread this misconception may be. That writer visited two or three stores, found them populated by experts on Klingons, and concluded that while "The volume market is in small businesses. . .no one has made an intelligent and serious effort to capitalize on it."

But he didn't look far enough. Some computer stores do offer excellent service and tools for business users. A Klingon fan would find some of them totally ignorant of the important things in his life, and deadly dull.

Computer stores are not like Pete Seeger's identical little boxes, as are many supermarkets, nor are they the McDonald's-like rule-book carbon copies found in many other fields. Computer stores have not been governmentally regulated into conformity with someone's idea of what is proper. Nor are their owners prevented by tradition from being, as is appropriate in this pioneering field, rugged individualists in what they do, and how they do it.

The business computing user is most affected by this variety in the interests and capabilities of computer stores. While the hobbyist can himself compensate for many of the average store's shortcomings, a business user needs a ready-to-use tool.

The novice user of business computers is especially affected because he may easily assume that any reputable business selling computers should have products which are good for him. Not true!

Most computer stores sell hardware — products analogous to nuts, bolts, and other miscellaneous parts. Most businesses, however, need totally assembled, tested, immediately operational, well supported, complete systems. Many computer stores do not frequently sell relatively expensive, high-quality hardware and software of the types best suited for the time-is-money user.

Finding a store with the products you need requires critical evaluation. But the first step is easy, even for the novice. When you first visit a computer store, directly ask about the type of products they carry. Do they sell and support real business systems?

Occasionally a dealer will answer, "No." Although clearly not a source for this product, a store this candid and knowledgeable is a real find, and one to be sure to return to when you are in the market for products they do handle.

Many other stores will answer, "Sure, we have this terrific (do-it-yourself) business system. All that you have to provide is the system design, programming, hardware maintenance, and. . ." Do you want to provide these things? If not, ask other vendors.

Do heed the advice a dealer gives about the limitations of his system. A prospective vendor is a prospective ally in a business venture. Let him know what you expect to give and get from a long term relationship with a computer system and its vendor.

Unless you are knowledgeably prepared to do it yourself, don't try to order a product from a store that doesn't want to handle it. Don't tell yourself a system will do more than its vendor says it will. Only buy from a dealer who does want to sell to you, on your terms.

This may be an apparently needless caution, but almost any computing vendor can cite examples otherwise. Customers, entranced by stories, or by their own visions of paperwork genies, have ignored knowledgeable evaluations of the impracticality of accomplishing their desired results with the equipment they've selected. Such customers have lost the critical vendor support and most likely have purchased a time sponge or an expensive boat anchor.

The second step in picking a computer store requires a more detailed critical evaluation of the capabilities of the vendor and his products. Some stores know less about businesses than you know about computers. Such stores may think that they offer business systems, when in fact they are selling toys.

A short discussion by a business person knowledgeable of his intended applications, will usually make the basic capabilities of a system and its vendor fairly clear. Review the limitations of the system proposed by the store. Evaluate characteristics important in your application, perhaps such as the maximum number of inventory items or employees that can be handled. All microcomputer systems have such finite limitations, and the knowledgeable vendor should be able to give you exact numbers that apply under various conditions, particularly yours.

You might also ask how easily the programs can be modified to handle your particular applications, who does that work, and at what cost. Other factors will tell you if there is any chance that this vendor and system will do your job for you. Some are maintenance support of hardware and software, and the cost of expanding your system as your business grows and your areas of computer application expand. Several other easy-to-ask-about decision factors have been covered in prior issues of INTERFACE AGE.

In conclusion, look for a combination of people and products ready to do what you want done. The people should be those you feel are competent, if not experts, in computing and business, as well as people you will feel comfortable working with for a long time.

If necessary, wait, and try the same stores, and new ones in the area, several months later. Some retailer's capabilities will change after they recognize the importance of the business market and understand the products these users need.

However, some buyers need understanding more basic than that resulting from an evaluation of computer stores. People who respond enthusiastically to $500 computer offerings, expecting them to be practical business systems, may be shocked by the $10,000 price tags which true business systems cost and are worth. Some may shortsightedly refuse to believe that there is reason for such differences in price, and thus forever search for a vendor who will give them something for practically nothing. Other prospective computer users are insisting on computers with capabilities which won't be realistic for several years, and thus they are missing today's benefits.

CIRCLE INQUIRY NO. 47

IBM AND TI COMPUTER STORES?

Speaking of computer stores, two new chains may be about to provide considerable competition. One is supported by the computer company that may be larger than all others combined, an often unconventional and aggressive organization. The other is supported by a world's leader in digital technology and the marketing organization that practically controls today's programmable personal electronic computation marketplace. These outlets may be the predecessors of ones that may considerably change the small business microcomputer marketplace.

IBM has opened several outlets, presently on a trial basis. Having much more in common with the traditional retail store than with the typical IBM sales approach, these are walk-in areas where anyone can visit, anytime during business hours.

These areas are also advertised to the general public, even on radio. This is quite a change from the past, when any IBM ads were rare, even in trade and professional publications.

IBM calls these areas demonstration centers, rather than stores. This designation is appropriate for at least one critical reason: systems are not available off-the-shelf. Their typical delivery time of weeks or months is similar to the delivery of other small business microcomputer systems ordered from the manufacturer.

These centers are dedicated to microcomputing—only the 5110 and related products are handled. Originally announced by IBM with its 5110 (which was discussed in this column in the March, 1978 issue of INTERFACE AGE), the actual occurrence of this approach is attracting considerable interest.

However, history is unlikely to repeat itself; IBM will probably not monopolize the business microcomputer market. Today's customers and products are considerably different from those of 15 years ago, and the marketing capabilities that bought success then will not be overwhelming in today's environment.

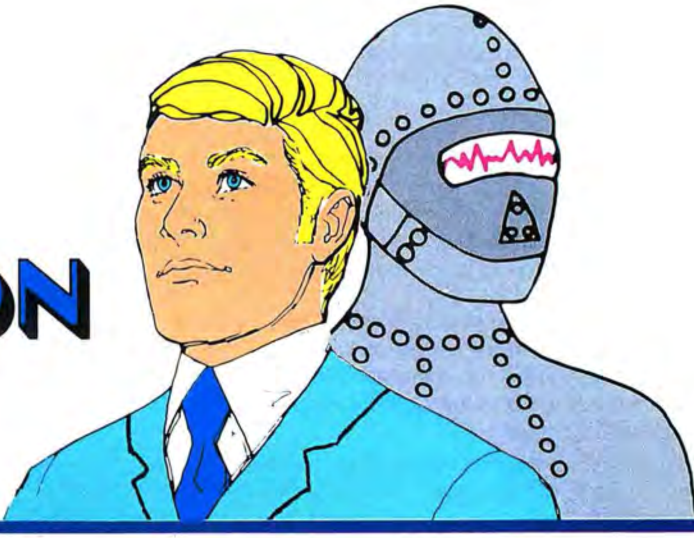
However, the IBM product's key characteristic is as important for business computer users today as it was yesterday. IBM designs, manufactures, markets, supports, documents, educates, and maintains their entire product — hardware and software. And their customers can easily procure an entire service package from one local vendor. This total service is important to most buyers in this market, a fact which these buyers will increasingly recognize with time.

Texas Instruments is another aggressive, successful, and well-supported marketing organization. Unlike IBM, TI has successfully concluded court cases threatening monopoly penalties, and so is relatively free to strongly influence the marketplace. Although TI's present business microcomputers are not generally considered outstanding, particularly in software, TI has proven that they can recognize market needs and delivery appropriate products when the time is right.

TI outlets are real stores which stock products and perform service. They are located in shopping centers (in Dallas, Houston and San Francisco), rather than the company office buildings which are the site of IBM's demonstration centers. In addition to these stores, TI is marketing its computing products through a variety of other dealers and company outlets.

Although an interesting topic for speculation, these IBM and TI outlets are not major factors in today's business microcomputer market. While they may have considerable future impact, many other computer stores today have a reasonable history, and strong present capabilities, of providing very useful and cost-effective products for small business computer users. □

THE MIND REVOLUTION



By Merl Miller

Last month we started a discussion about how a programmable controller operates and how it is different from a robot. Before starting on this month's discussion, you might want to review last month's.

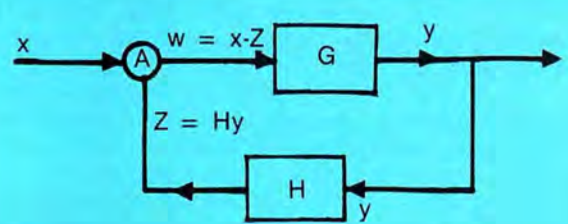


Figure 1.

Let's start where we left off. In Figure 1 you will see a controller with a gain added.

- x is the input
- y is the output
- G is gain
- H is extra gain
- Z is a multiple of H and y
- A is a sensing device which changes the input from x to x-Z

If, for the time being, we assume that H is equal to 1 (one), then we can look at the effect frequency has on gain. Let's use these frequencies and gains:

Chart 1

	Frequency (CPS)	Gain (G)
f_1	10	10
f_2	100	35
f_3	1,000	50
f_4	10,000	100
f_5	100,000	20
f_6	1,000,000	10

As you can see, with an input of 1 the output varies a great deal and is quite inconsistent.

Now, let's give H a value of .075 and see what happens. We can calculate system gain if we use the robot equation:

$$y = \frac{G}{1 + GH} x$$

A simplified version of system gain would be: System gain is all of the gains operating on the input as supplied to the output. Giving H the value of .075 and applying the robot formula to the chart above, we have:

Chart 2

	Frequency (CPS)	System Gain (SG)
f_1	10	5.71
f_2	100	9.66
f_3	1,000	10.53
f_4	10,000	11.76
f_5	100,000	8.00
f_6	1,000,000	5.71

As you can see, adding another gain characteristic has stabilized the system. It doesn't have the fluctuation it had before. As you add gains, you can further stabilize your system. If you added enough gain you could build a nearly stable system, but that is unrealistic. A physical system is never completely stable. An ideal system is shown in Figure 2. For an input of *x*, the output *y*, is stable as a function of time.

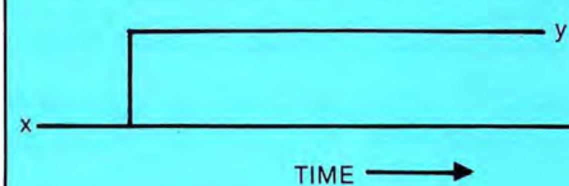


Figure 2.

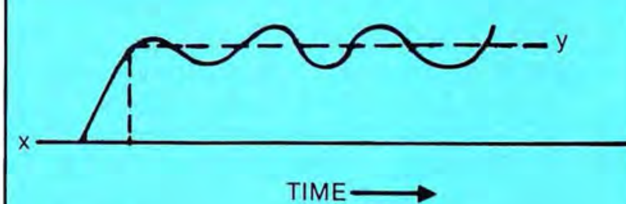


Figure 3.

In an actual physical system, the output would vary as shown in Figure 3. The dotted line represents an ideal system that we would use to simulate the real system. It's sort of like saying you spend $200 per month on food when you spend $175 one month, $225 the next, $190 the next and so on. The $200 a month is an *ideal* system and what you actually spend is a *real* system.

Branched to Page 29

JURISPRUDENT COMPUTERIST

By Elliott MacLennan
Attorney-at-Law
Stephen Murtha

Many factors motivate the entrepreneur to strike out on his own and start a business. He may have recently been fired or laid-off, passed over for promotion once too often, talked into it by a friend, etc. The list goes on forever, but all of the reasons can be lumped into two general categories; financial compensation, and the overall quality of the work environment. Financial compensation covers things such as salary, fringe benefits, the size and frequency of promotions, etc. The overall quality of the work environment encompasses being acknowledged for your contributions, the quality of the physical work environment, having the possiblity of seeing your ideas put to use sometime in your lifetime, and many other subjective, yet extremely important factors. In the next two columns we will deal with the former of these two categories, financial compensation, and explore ways in which the entrepreneur can maximize the financial rewards of his labors.

One of the potential rewards, and hence the attraction, of striking out on your own is the ability to acquire personal wealth as a result of owning a successful business. We all know or have heard of someone who started his business in a garage and after four or five years of phenomenal growth sold out for millions of dollars to Computer Conglomerate Inc. and retired to Tahiti at the ripe old age of 37.

Fortunately, selling a business for a profit is not the only way in which the entrepreneur can be rewarded for his labors. There are two other ways in which he can use the business to further his own financial goals. The first of these two is terribly obvious, but bears repeating for the sake of completeness. Make your business profitable. Too many entrepreneurs stop working hard once their business is out of the survival period, and the business never reaches its full potential. Unless you have a stable and profitable business, you will not attain any degree of financial security. The second method is to make the maximum use of the business entity to further your own financial goals. The business is yours, make it serve you. The focus of this and the next column will be on making the maximum use of the business for this purpose.

The cardinal principle involved in using the business to serve you has to do with deductible business expenses. If you can structure your financial transactions in such a way that expenditures that you would ordinarily make with your after tax dollars can be classified as a deductible business expense, and hence paid with pretax dollars, the results can be significant. When an expense can be shifted from the after-tax to pre-tax category, a savings of one half is usually effected.

The "catch" to all of this is that in order for many of these expenses to be made deductible, they must be only for employees of a business, and not the owners. The only business form in which there is no restrictions is the corporation. The tax law makes no differentiation between employees and owner-employees. As we mentioned in the two columns on Sub-chapter C corporations, this is the primary determining factor for the small business in the selection of a business form. If the tax savings realized by shifting expenses to the business from the individual do not offset the added cost of doing business as a corporation, then the business should stay unincorporated unless other factors override the tax considerations.

One of the areas in which non-deductible expenses can be made deductible is in what are called employee benefits or fringe benefits. By this we mean things such as group insurance, sick leave, pension and profit sharing plans, etc. The entrepreneur needs to give them close attention for two reasons. The first reason is that he may have financial responsibilities and goals that require life, disability and medical insurance. If he relied on his previous employer to provide these benefits for him, then it is necessary to replace them when he starts his own business. The second reason why these benefits are often necessary is the need to attract and retain quality employees. The computer industry is an extremely competitive one, and the quality of employees in a company may make the difference between its ultimate survival and success, or its extinction. It is possible to hire employees at minimal wages to do task jobs, but you will have to pay for creativity. Since creative talent is definitely a limited resource, you will have to compete with some very generous pay packages offered by some of the other larger computer firms.

The first employee benefit most firms provide is group insurance. There are basically three different types of group insurance; life, disability or wage continuation and medical reimbursement. We will take a look at each one separately. A company may provide up to $50,000 of group term insurance to an employee without the cost of the insurance being reportable as income to the employee under Section 79 of the Internal Revenue Code. Above $50,000 a cost is imputed to the employee using government's Table I. This cost must be reported by the employee on his tax return. However, even this is better than purchasing the insurance on your own, since Table I costs are must lower than premiums for actual insurance.

The other two types of group insurance, wage continuation and medical reimbursement plans are interrelated from a tax point of view. A wage continuation plan provides for a monthly benefit to be paid to an employee in the event of disability. A medical reimbursement plan allows a corporation to reimburse medical expenses incurred by an employee. From the standpoint of the IRS, these plans may be self-insured or backed up with insurance. Many large corporations will self-insure, but for most medium and small size companies, securing insurance is the only way to provide reasonable certainty that the promised benefits can be paid without bankrupting the company in the event of a claim. Any premiums or benefits paid by the corporation under a plan are tax deductible by the corporation.

In order for these payments to receive favorable tax treatment with respect to the employee, a written plan must be initiated prior to the disablity or medical expense being incurred. If this is not done properly, all payments will be taxable as income to the employee and not deductible to the corporation. Obviously, this is to be avoided at all costs as this is the worst possible tax situation to be in.

Under a properly set up wage continuation plan, an

we're looking for someone serious about personal computing!

8-bit? 16-bit? The better of the two? The question is elemental – hardly worth consideration. What matters is your "machine's" CPU, its "architecture," and most importantly its instruction set. That's where the power is and that's exactly why we're telling you about the KD11-F.

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Fact: The KD11-F's PDP-11 instruction set has the most powerful repertoire of instructions of any computer in its price class.

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GEORGIA – Atlanta, 5285 Roswell Rd. (404) 252-4341.

ILLINOIS – Chicago, 3462-66 W. Devon Ave. (312) 583-3920; **Chicago (Downers Grove),** 224 Ogden Ave. (312) 852-1304.

INDIANA – Indianapolis, 2112 E. 62nd St. (317) 257-4321.

KANSAS – Kansas City (Mission), 5960 Lamar Ave. (913) 362-4486.

KENTUCKY – Louisville, 12401 Shelbyville Rd. (502) 245-7811.

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MARYLAND – Baltimore, 1713 E. Joppa Rd. (301) 661-4446; **Rockville,** 5542 Nicholson Lane (301) 881-5420.

MASSACHUSETTS – Boston (Peabody), 242 Andover St. (617) 531-9330; **Boston (Wellesley),** 165 Worcester Ave. (Rte. 9 just west of Rt. 128) (617) 237-1510.

MICHIGAN – Detroit, 18645 W. Eight Mile Rd. (313) 535-6480; **E. Detroit,** 18149 E. Eight Mile Rd. (313) 772-0416.

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NEW YORK – Buffalo (Amherst), 3476 Sheridan Dr. (716) 835-3090; **Jericho, Long Island,** 15 Jericho Turnpike (516) 334-8181; **Rochester,** 937 Jefferson Rd. (716) 244-5470; **White Plains (North White Plains),** 7 Reservoir Rd. (914) 761-7690.

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VIRGINIA – Alexandria, 6201 Richmond Hwy. (703) 765-5515; **Norfolk (Virginia Beach),** 1055 Independence Blvd. (804) 460-0997.

WASHINGTON – Seattle, 505 8th Ave. North (206) 682-2172.

WISCONSIN – Milwaukee, 5215 W. Fond du Lac (414) 873-8250.

CIRCLE INQUIRY NO. 21

employee may receive up to $100 per week of tax-free benefits during a period of disability. Any income over this $100 per week is taxed as ordinary income. This exclusion is reduced dollar for dollar for income in excess of $15,000 per year. These rules apply, however, only to plans in which the corporation pays the entire premium. If the employee pays any or all of the premium for the insurance providing the benefits, then that *pro rata* share of the benefit payment is free of income taxes completely. For this reason, if the employees are going to help pay for their benefits, this should be the first place where these contributions are applied.

Payments made under a medical reimbursement plan are entirely free from income taxes, provided the payments are made for costs actually offered (within limits) to different employees. For example, a plan may be set up under which the rank and file employees pay the first $100 of medical expenses and the officers have that $100 paid by the corporation. The premiums and benefits allocated to dependents of employees receive the same tax treatment.

Our next column will pick up where this one left off and cover pension and profit sharing plans, deferred compensation plans, and communicating benefits to employees.□

The material presented in this column is intended for the reader's general information. The authors request that the reader consult professional advisors prior to applying this material to his or her specific situation. Anyone seeking further information can contact the authors directly at:

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3 Altarinda Dr., Suite 304, Orinda, CA 94563

THE MIND REVOLUTION

Vectored from Page 24

Call the dotted line in Figure 3 a stability criterion. The peaks and valleys of the output curve y, are called overshoots. These overshoots are in direct proportion to the amount of system gain you allow in your system. Now, let's assume you have an output signal like the one shown in Figure 4. It has tremendous overshoots. You can stabilize this system by adding another gain characteristic. But there are other ways of stabilizing it. These have to do with the system learning.

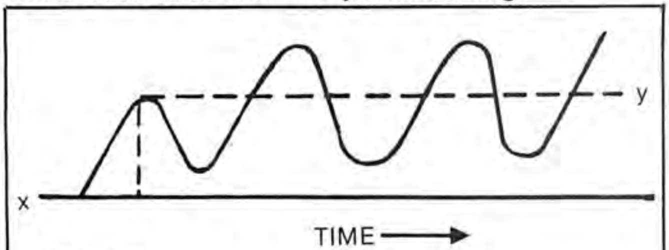

Figure 4.

What if the system could learn to stabilize the signal itself? For now, let's now worry about how this can be done. Let's just ask the questions, "What if you built an unstable system that could stabilize itself? And what if this could be done without physically altering the system? And what if you could build several systems that could solve the same problem and each system devised its own method?" If you can build a machine that answers *all* of these "what if's" then, and only then, will you have a machine that thinks. How well it thinks and what you can do with it are the kinds of questions we'll explore in the next few months.□

Puzzled About Computers?

Data Dynamics Technology has a library of answers . . .

1

6800 Programming For Logic Design
By Adam Osborne. 310 pages, $7.50
This book explains how an assembly language program within a microcomputer system can replace combinatorial logic — that is, the combined use of "off-the-shelf," non-programmable logic devices, such as standard 7400 series digital logic.
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2

Build Your Own Working Robot
By David L. Heiserman
234 pages, $5.95
Here are complete instructions, plans, schematics, logic circuits, and wiring diagrams for building Buster, the most lovable (and mischievous) mechanical pet in the world! He'll serve you coffee or bring you the morning papers. He'll forage for his own "food" and scream when he can't find it. His "curiosity" will get him into one plight after another, but Buster has the capacity to get himself out of trouble just as easily as he got into it!
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3

CMOS Databook
By Bill Hunter. 280 pages, $6.95
Here's the complete data book on what Complementary Metal Oxide Semiconductors are all about — how they're constructed, how they operate, how they're packaged, and how they're interfaced with sophisticated ICs, how they're powered, and how you can use them to design everything from digital timers to super-efficient test equipment.
Order No. TB984, paper.

4

Computer Dictionary
By Donald D. Spencer
160 pages, $5.95 paper; $9.95 hardbound
This current and comprehensive dictionary contains about 2,000 words, phrases, and acronyms used in connection with computers. The keynote of this book is clarity — without sacrifice of authority and definitional precision. All definitions are simple, and stand as independent units of explanation. This book was written for all those who, in their work or in their studies, become involved with computer technology.
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5

A Quick Look At BASIC
By Donald D. Spencer. 64 pages, $4.95
A short, to-the-point introduction to the BASIC programming language. It is intended to serve as a self-instructional book designed for either the reader who has little or no knowledge of computers or computer programming, or for the person who wants to learn BASIC quickly. This text introduces the student to the essentials of the BASIC programming language in a clear and simple manner. The emphasis is on giving the student the ability to use the computer to solve problems as quickly as possible.
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Basic BASIC: An Introduction to Computer Programming in BASIC Language - Second Edition
By James S. Coan. 288 pages, $8.95
The author uses over 100 sample programs to illustrate the essential techniques of the language and to integrate BASIC programming with mathematics. Each language statement or capability is clearly explained at the time that it is first used in a sample program. Every section is followed by practice problems.
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7

Advanced BASIC
By James S. Coan. 192 pages, $7.95
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8

Microcomputers: Structure and Programming
By T.G. Lewis, and J.W. Doerr.
282 pages, $13.95
This introductory text on assembly language, machine architecture, and small machine algorithms is designed for use in computer science courses using small computers. It thoroughly introduces the reader to minihardware and then covers all the essentials needed to program a minicomputer.
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9

8080 Machine Language Programming for Beginners
By Ron Santore. 104 pages, $6.95
This is a book for beginners. In it you will learn the fundamentals of 8080 machine language programming. This book will take you step by step through the most common 8080 op codes and it will do so at a level anyone can understand. The author is not trying to impress you with unfamiliar words. Terms are defined as they are introduced, so no computer background is required.
Order No. DP14-2, paper.

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Microprocessor Interfacing Techniques - Second Edition
By Austin Lesea & Rodnay Zaks.
412 pages, $9.95
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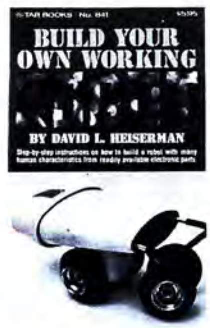

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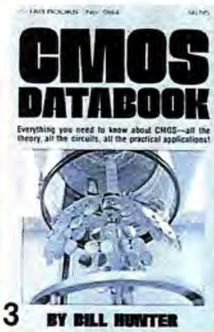

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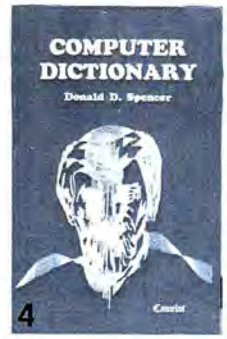

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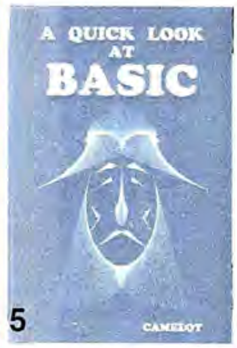

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12 TYCHON's 8080 Octal and Hex Code Cards

The code cards are a sliderule-like aid for programming and debugging 8080 software. Both cards contain all the standard mnemonics and either their corresponding octal or hex codes. The pocket size cards are 6.5 by 3 inches (16 by 8 cm) with color-coded instructions to provide a neat, logical format for quick reference. The back of both cards is printed with an ASCII code chart for all 128 characters plus the 8080's status word and register pair codes.

13 INTERFACE AGE Binders and Slip Cases

Collecting magazines can bring headaches — not to mention dust, ripped pages and misplaced copies. If you use your back issues of INTERFACE AGE as reference material, nothing is more annoying than taking time to find mislaid copies. Data Dynamics Technology is now offering deluxe binders and slip cases which will place each back issue of INTERFACE AGE at your fingertips. Each binder and slip case is constructed of a handsome blue vinyl with INTERFACE AGE stamped in gold foil on the front cover and spine. These rugged binders and slip cases can hold 12 issues each and will protect your back issues of INTERFACE AGE for years.

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Miniprocessors: From Calculators to Computers
By David L. Heiserman. 195 pages, $5.95
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By Donald D. Spencer. 166 pages, $6.95
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By Donald D. Spencer. 192 pages, $7.95
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By Donald D. Spencer. 128 pages, $5.95
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By James White. 200 pages, $6.00
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Microprocessors: From Chips To Systems
By Rodnay Zaks. 416 pages, $9.95
Order No. C201, paper

Prices quoted subject to change without notice.

13

12

11

CIRCLE INQUIRY NO. 11

. . . FROM THE FOUNTAINHEAD

By Adam Osborne

I have received many letters and telephone calls from people seeking advice on what microcomputer system hardware or software to buy. I can understand customer apprehension in this fast-moving industry; therefore, I would like to answer this question for everyone. This is what you should do:

1. Define your objectives. That is to say, write down as completely and clearly as you can what it is you wish to gain from having your own microcomputer system.
2. Contact at least three (and preferably six) computer stores, either by visiting the stores in person or by writing to them. If you have not come up with a precise configuration, then ask the computer stores to suggest a configuration.
3. Using a summary of computer store suggestions, or based on your own selection, you should make the following decisions:
   a. What programming language you will use.
   b. How much memory you will require.
   c. What peripherals your system will include.
   d. What canned applications programs, if any, you will get.
4. Now comes the hard part—choosing brands. Go back to your six computer stores and ask them to select the brands which they would recommend for each hardware and software component. Computer stores are the only places where you can get timely and accurate information on product quality.
5. Make a summary of recommended products, and configure your system selecting those products that received the most recommendations. Now pick the computer store that gave you the best overall advice, and reward them with your business.

If you follow the above steps, you will minimize the risk of buying junk and you will have qualified the computer store with which you will be doing business for a long time to come.

Micro-Business '78 was an interesting show. Being specific to microcomputers used for data processing, it attracted far fewer attendees than the West Coast Computer Faire; but, after talking to exhibitors, it is clear that people were in a buying mood.

A tremendous number of small companies are springing up, with the sole aim of developing microprocessor-based systems. Very few of these systems have, as yet, been installed. If microprocessor-based business systems fail as an industry, it will not be for want of trying. But, I believe that microprocessors will work out in business applications. There will undoubtedly be numerous casualties on the way, since many of the new companies are run by people with no prior business experience. These new entrepreneurs do not bother to check out the mistakes that have been made by people who came before them. Remember, the microcomputer-based business system of today costs one-tenth of the minicomputer-based system of eight years ago; otherwise, there is very little difference.

Let me give you a scenario for the new "microcomputers in business" company most likely to fail. It has a group of programmers quite convinced that their only problem lies in getting the job done as quickly as possible. According to these guys, business data processing programs are easy to write — in fact, there is nothing to them. Microcomputer hardware configurations, even in their most limited form, are more than adequate for almost any business application; all it takes is a little trickery on the part of clever programmers to get what is needed out of the system. These programmers are also convinced of their own cleverness. A company like this one will last about nine months: three months to dig themselves into a hole, another three months to survey the hole, and a final three months to figure that they cannot get out of it.

Here is a scenario for the successful company: the people in this company assume that they are bright guys — bright enough to know what mistakes have been made in the past, and bright enough not to make the same mistakes again. They check out programs that have been tested by time and are available for little or no cost. They carefully evaluate the capacity and processing speed of the microcomputer system they are installing. They make sure that there is a reasonable margin for error in everything they do. They are far more interested in guaranteeing a profit than they are in pride of authorship. Wherever possible, they look for potential problems, and they prepare solutions to those problems. And, above all, they realize that it is better to be six months late and absolutely right.

Now let me explain why microcomputers in business applications have such a bright future.

The configurations being sold today are limited, but adequate. Two floppy disks provide up to 500,000 bytes of slow-access bulk storage. Add a microcomputer with 32,000

bytes of memory, plus a reasonable printer, and you have a system that ranges in price from $5,000 to $10,000. Many companies can afford this price and live with this performance.

But, right now there are half a dozen companies working on a new family of revolutionary fixed-disk systems. Control Data Corporation's "Hummingbird" project is typical of this new disk technology. "Hummingbird" will come in a box about the size of a stand-alone floppy disk drive. Instead of having a floppy disk, it will have a fixed disk, about the size of a floppy disk, rotating at more than 50,000 rpm. This tiny fixed disk will have a storage capacity ranging between 10,000,000 and 15,000,000 bytes, with data transfer rates in excess of a million bytes per second. And here is the best part: it will retail for less than $3,000. 10,000,000 to 15,000,000 bytes of high speed disk storage for less than $3,000, in a box no bigger than a single floppy disk drive, will make a big difference to business data processing systems. These disk units should be available by the second quarter of 1979. By mid-1979 (and probably not much sooner) the Intel 8086 and Zilog Z8000 Central Processing Units will be available; these CPUs are the equal of any minicomputer today. I do not need to paint pictures for anyone to see the rosy future awaiting microcomputer-based business systems.

. . .right now there are a half a dozen companies working on a new family of revolutionary fixed-disk systems.

While I was at Micro-Business '78, I spent some time chatting with Dave Freeman and Rinae Morris of Advanced Computer Products. I have known of Advanced Computer Products for some time, and it was a gross oversight on my part not to mention them in my March column as one of the "good guys" in the mail-order business. Dave's policy is to demand cash-in-advance only for orders of $25.00 or less, while giving significant discounts for cash with larger orders. Dave will not hold your money for any back-ordered item without your express permission, and he gives refunds for products returned in good condition, without asking questions. I have never received a complaint about Advanced Computer Products, and have heard only good things about this mail-order operation. Their address is:

Advanced Computer Products
1310 "B" E. Edinger
Santa Ana, CA 92705
(714) 558-8813

Another name to add to your "good guys" list is Jade Computer Products. They can be reached at:

Jade Computer Products
5351 West 144th Street
Lawndale, CA 90260
(213) 679-3313

I suppose I should mention the Heath Company as one of the good guys in the mail-order business. It seems almost gratuitous to state that Heath, with their fine reputation, are good guys; but just to keep the record complete, let me tell you that they are.

I believe Vector Graphic is one of the sleepers in the microcomputer field that is likely to emerge as a dominant force over the next 12 months. Vector Graphic is a small, conservatively run company that has concentrated on being good rather than on being first. They sell almost exclusively through computer stores, discouraging direct mail-order business. I believe a few other microcomputer manufacturers would do well to follow Vector Graphic's marketing policy.

At the other end of the business spectrum, IMSAI has recently been telling its dealers that they must each send cashier's checks for $2,000, simply for the privilege of continuing to order IMSAI equipment. This is a privilege which frequently means paying cash now for products delivered at some unspecified future date. Come on, guys, you could get away with it a year ago, but no more!

It has been rumored that Pertec is disappointed with the performance of MITS and is anxious to sell MITS cheap. I have investigated this rumor carefully and have found no evidence to substantiate it.

I received a letter from Bill Gates, president of Microsoft. Bill had some interesting comments regarding future software pricing.

I maintain that applications programs will in the future cost very little, due to high sales volume. From an economic standpoint, low applications software prices will be justified by the sale of good accompanying documentation.

People will no longer tolerate the useless documentation which has in the past so frequently accompanied software products. On the other hand, users will pay a reasonable price for a reasonable manual. While software can be copied inexpensively, most people will buy a user's manual rather than run around with a bunch of duplicated sheets of paper. In other words, I am suggesting that applications programs will in the future be given away free, while the manual accompanying the applications programs will be sold, and will become the source of revenue for the software vendor. That means that documentation must be good enough to sell. This logic makes no sense to Microsoft, or to anyone else who provides system software. For every thousand people who need a manual describing an applications program such as payroll, perhaps one person needs an application program describing the disk-operating system upon which the payroll depends for its existence. Therefore, Bill Gates is obliged to charge much more for this software, since he has fewer direct customers and a negligible business in accompanying manuals. We, as an industry, must make sure that Microsoft and other system software manufacturers are adequately compensated and protected from theft, since without system software nothing else could exist.

Anyone who steals system software, rather than paying for it, is contributing to the demise of the entire microcomputer industry. As a group, we should develop extreme prejudices against theft of system software, and we should have no compunctions about turning in known thieves. If Microsoft and companies like it do not survive, none of us will.

I am very impressed with the range of software products that Microsoft has introduced, or is soon to introduce. Their BASIC has become the standard of the industry. They are now producing APL, FORTRAN, and COBOL for microcomputers. For more information on Microsoft, you can contact them directly at:

Microsoft
819 Two Park Central Tower
Albuquerque, NM 87108
(505) 256-3600.

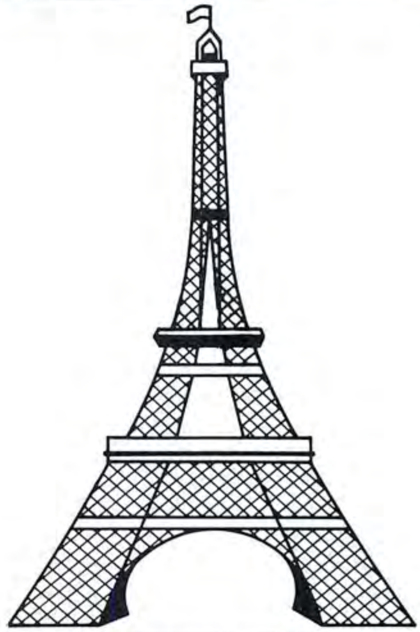
An interesting applications program which was brought to my attention recently is a small general ledger system available from Compumax. This is a somewhat limited system, but it will run on relatively small microcomputer configurations. For small businesses, the Compumax general ledger appears to be an excellent buy. Compumax may be contacted at:

Compumax Associates
Suite 306, 505 Hamilton Avenue
Palo Alto, CA 94301
(415) 321-2881

□

CIRCLE INQUIRY NO. 32

EUROPEAN INTERFACE



By Hans Drewitz and Roland Hesse

Sometime in 1976, I asked my dentist if he could imagine using a computer. His answer was very clear; "No, it's too expensive and too complicated." When I told him that the time is near when he could buy a business computer for about ten thousand dollars that would not be more complicated to use than a typewriter, he became interested.

The time is now here. Dentists in France and Germany are already beginning to take advantage of microcomputers. They primarily use them to store and handle patient records. When a new patient arrives, he and the dentist will fill out a questionnaire with all the administrative and medical information needed. An assistant types it into the computer, verifying the information on the screen and storing it on floppy disks. When the patient returns, the medical assistant recalls all the necessary information by typing the name into the system and printing it for the dentist. At the end of the session with his patient the doctor adds information to the record, such as the work done, the payment received, and date the patient is to return, or the treatment plan worked out. The record is returned to the assistant for updating the computer file and is filed by date as a hard-copy backup. If for any reason the computer does not work the dentist goes back to the last paper copy of the record and continues to add information to it.

The advantages are obvious: better organization, faster administration, and less effort, creating better business results. The computerized access to the file makes it possible to print standard letters to inform the patient of a checkup, remind him that his payment is due or send him the treatment workplan as an estimate. The information needed to fill out papers for social security or insurance reimbursement is readily available on the screen and the forms can be filled out automatically if the form design permits this. The information stored can be used to generate statistics and lists, and for the first time the sophisticated dentist has a possibility to analyze this data as a basis for business decisions. For example, by simply recording the time

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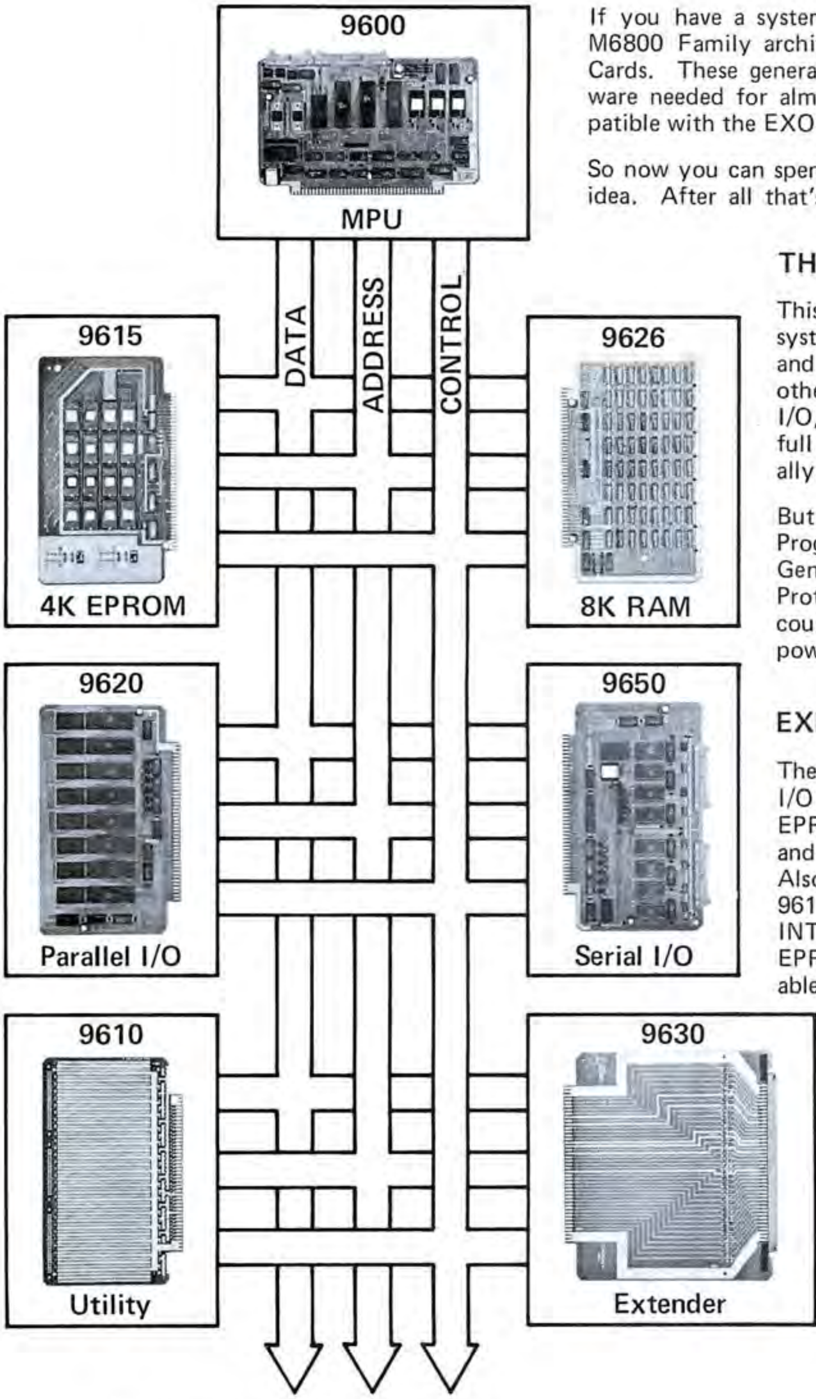

If you have a system design chore and prefer the advantages of the M6800 Family architecture, you should have a look at our Deck of Cards. These general purpose support modules provide all the hardware needed for almost any system and they're bus and outline compatible with the EXORciser* and Micromodule* Family.

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The 9600 is supported by a variety of memory and I/O cards like our 9626 8K Static RAM, the 9615 4K EPROM, the 9620 16 Channel Parallel I/O Module, and the 9650 8 Channel Duplex Serial I/O Module. Also coming this year are the 9616 32K EPROM, the 9612 INTELLIGENT Analog I/O Module, the 9643 INTELLIGENT Floppy Disc Controller, the 9617 EPROM Programmer, the 9640 Multiple Programmable Timer Module and the 9645 Video Controller.

Wrap up your system in our 9601 Card Cage with a 9602 Mother Board and a built-in 9604 Switchmode Regulating Power Supply. Then develop your applications program with our support software which includes a BASIC Compiler to produce fast-executing code.

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spent for a specific type of procedure a productivity report by work classification can be generated.

This application is a typical example of how the microcomputer revolution is being implemented in small businesses. As a result of this my dentist will soon have a computer.

Text processing is also a very attractive application for microcomputers. It can easily help justify the purchase of a microcomputer system for a small company. Presently a variety of text processing programs are available. In the U.S., text processing can be implemented with just an upper and lower case keyboard, a screen, a storage media, a printed output and the application software. In Europe the same equipment is needed but some unique problems exist, complicating text processing implementation. The different characters found in languages such as German, French, Spanish, and the Nordic languages are creating very special problems. Keyboards and screens have to be modified to allow for these characters. Also the placement of even the standard alphabet characters on the keyboard vary from language to language. As long as an operator or programmer works on a CRT this is not a problem. But if a secretary is to use a text processing system efficiently, it is necessary to find the keys in the same place as a usual typewriter.

Another important factor is that the input representation (the internal code) of a character is identical to the one used by the output device to print the very same letter. This can be quite a challenge if you have to coordinate an IBM typewriter with a German golf ball and a U.S. CRT.

Companies manufacturing keyboards, screens, video interfaces or CRT's should make it easy and inexpensive to change character placement and to replace some special characters with characters needed in different languages. Character generators should include foreign characters or at least have the capacity to be modified to include them.

In writing text processing programs, be aware of these problems and if special characters are used for program functions, clearly document it.

One of the first computer shows in Europe every year is the "Printemps Informatique" at the U.S. Trade Center in Neuilly, a suburb of Paris. The show is organized by the U.S. Trade Center in connection with the U.S. Chamber of Commerce. All the equipment exhibited has to be of American origin.

This year marked the fourth anniversary of the show. Aproximately 120 American companies were represented, including: Texas Instruments, Digital Equipment, Tally, Okidata, Diablo, Control Data, Ampex, Centronics, Shugart, Wangco, Pertec, Tektronics and Hewlett-Packard. In general the show addresses the OEM market.

Another objective of the exhibition is to provide American companies the opportunity to establish distributors in France or Europe. Consequently, a large part of the exhibition concentrates on peripheral equipment such as printers, disks, and terminals. Only a few complete microcomputer systems were exhibited at the show. Zilog presented its MCZ and PDS systems. Eurapple (the European organization for Apple Computer Company) was there with its system and Euro Computer Shop demonstrated the IMSAI 8080, North Star's "Horizon" and MITS' Altair.

The public interest was very encouraging. The show will be followed by the SYBEX microcomputer show on May 23-25. □

784 Reasons to Celebrate

The party's over for all dumb terminals and a lot of smart ones too. But, at $784 (quantity one), the party's just beginning for Intertec's INTERTUBE.

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There's an INTERTUBE celebration going on near you. Contact us at one of the numbers below for the name and location of the nearest party. We'll be surprised if you don't come (BYOB). Happy INTERTUBE!

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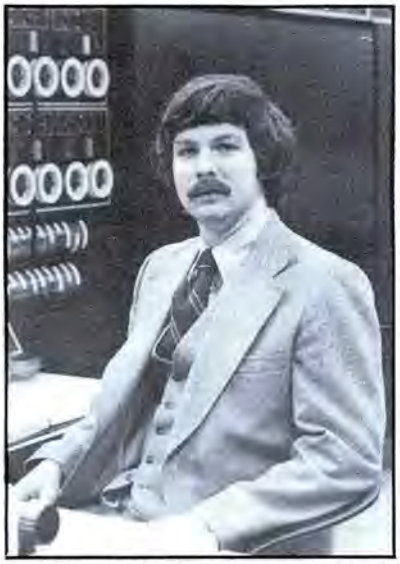
CIRCLE INQUIRY NO. 23

* 50-99 QTY./5-49 $800/1-4 $995

SENSE LINE

The Physicians Microcomputer Club

By Dr. Gerald M. Orosz, President



The Physicians Microcomputer Club is the largest organization in the country dedicated to bringing microcomputer technology to bear in solving the business and medical care problems of private, and hospital-based physicians. Approximately ninety-five percent of the membership consists of hospital-based physicians, private practitioners, and medical school staff. The remaining five percent are medical data processing consultants.

The club publication, "The Physicians Microcomputer Report" is published on a monthly basis with a printing of 10,000 copies, and is circulated throughout the United States and Canada. "The Physicians Microcomputer Report" is a typeset magazine containing articles on medical applications of dedicated microcomputers; medical electronic technology forecasts; reviews of the latest developments in microcomputer hardware and peripheral equipment; and articles on the application of microcomputers in analysis of stock, real estate, tax, and other areas of interest to medical professionals.

Programs, written in BASIC, on both business and medical applications are developed at the request of members and published on a monthly basis. Medical and business programs for handheld programmable calculators are also published in each issue. Physicians are encouraged to submit programs, their personal experiences with microcomputers, and problems that they would like to see attacked in magazine articles.

At the present time local club activities are in the formative stages. The national nature of our membership opens the possibility of a national annual symposium, although this is subject to the expression of sufficient interest by the club membership.

No advertising is presently being published in the "Physicians Microcomputer Report." However, there has been considerable interest expressed by a number of members with regard to the purchase of equipment and software oriented toward solving the medical and business problems of physicians. If you are a hardware manufacturer, software writer, publisher, physician, or just an interested party; our membership is open to you. If you feel that you have a product that would be of interest to medical professionals and would like a reasonable way of reaching this market, please contact us for more information.

Annual membership fee, which includes twelve issues of the "Physicians Microcomputer Report," is $25 and can be obtained by sending a check to the address given below. Advertising information can be obtained by writing to the same address.

Dr. Gerald M. Orosz, President
The Physicians Microcomputer Club
Box 6483
Lawrenceville, NJ 08648

Southern California Users of RT-11

By Mark Bartelt

SCURT (Southern California Users of RT-11) is, as its name would imply, the RT-11 local users group (LUG) for the southern California area. Although most of its membership comes from Los Angeles and Orange Counties, it also includes users from as far north as Santa Barbara, and as far south as San Diego.

SCURT is probably the most active RT-11 LUG, and may likely be the largest as well. There are currently over 150 members, and the group is growing rapidly.

Meetings are held four times per year (in February, May, September, and November) at 9:30 A.M. on a Tuesday, usually (but not always) around the middle of the month. At present, the group has a semi-permanent meeting place on the USC campus; new members should be aware, however, that this may not always be the case.

SCURT meetings usually include a technical presentation (how to do something useful and non-trivial) and/or an application talk (a description of an interesting RT-based system which a user has built).

The meetings also give RT-11 users the opportunity to interact with users who have similar interests, and who may have experienced similar problems and difficulties. This interaction has proven worthwhile both for new members, who can draw on the experience of others for answers to the sorts of questions new users tend to have, and also for more experienced users, who may be having problems with more sophisticated RT-11 applications.

Because the LUG is so active, there is a good deal of communication between SCURT and DEC's RT-11 development group. During the fall meetings, RT-11 users offer suggestions for what they'd like to see in future releases of the operating system. A large wish list is compiled from these suggestions, and a vote of the membership is taken in order to reach a consensus as to which items are most important to the group as a whole. DEC has been extremely responsive to SCURT's suggestions in the past (a number of the new features present in V3 grew out of previous SCURT wish lists), and it appears likely that they'll continue to show a high level of interest in what the group has to say.

In addition to holding meetings, SCURT also maintains an extensive library of programs contributed by members.

To be put on the SCURT mailing list, contact Ray Rittenhouse (the DEC El Segundo office's RT-11 guru) at (213) 640-1830, ext 225. For more information about SCURT, call Mark Bartelt at (213) 795-6811, ext 2663. □

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1978 INTERFACE AGE

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We wish to offer our appreciation to the editors and publishers who contributed to the first conference.

Personal Computing Is More Than A Hobby

By Portia Isaacson
Electronic Data Systems
Incoming COMPUTER Technical Editor
and
Jack Grimes
Tektronix, Inc.
COMPUTER Technical Editor

Computer Magazine is the journal serving the IEEE Computer Society. Computer presents articles geared to keep the engineering community advised of current advances in both the fields of hardware and software.

Hobby computing is experimenting with the hardware, programming, and building applications just for the fun of it, in order to learn more about computing and sometimes to get the application constructed. As with many hobbies, people are drawn to computing because it is a creative pastime. After the initial investment, little additional expense need be incurred in order to spend endless hours creating programs for a seemingly limitless variety of applications.

In addition to the technical aspects of hobby computing there are the human aspects. As with many other hobbies, the identification of the individual with a group of other people with similar interests is important. This need for identification gives rise to clubs, T-shirts, posters, and bumper stickers. The computer hobby will probably be established as the elite among hobbies — an image that will be of more than minor significance to its growth. Another important reason people are drawn to the computer hobby is its educational value. Most of our jobs and certainly all our daily lives are touched by computers. What better way to learn about computers than in the privacy of our own home? Many people can use the knowledge gained in their computer hobby to advantage in their work. Some will even turn their hobby into a money-making activity by selling applications software. Others may earn salary increases because of their knowledge of computing. Still others will become computer professionals. In the early years of computing we experienced a similar phenomenon when many users of computers crossed the bridge to become computer pros. The educational aspects of hobby computing make it clear that all is not just fun and games.

There is a danger that the rambunctious new personal computing movement will be overshadowed by its hobby or amateur aspect. And that would surely lead us to overlook several facets of personal computing that are of significant interest and importance to the computing profession. Figure 1 shows personal computing — as we see it emerging — comprising several related areas: business uses of personal computers, educational uses of personal computers, personal computing research, product development for personal computing, hobby computing, and home computing. These several facets of personal computing are related primarily because they were all made possible by technological achievements that gave birth to the newest member in the evolution of computing systems, a computer low enough in cost to be dedicated to a person, home or office.

Business uses of personal computers include the many emerging applications of computers that are sufficiently low in cost to dedicate to a small office — often to one person. Applications range from text editing to traditional business applications, such as accounting for small businesses. Large businesses will use many personal computers distributed throughout the organization. Instead of taking the application to the computer, computer power will be taken to the application. Some of these personal computers will be connected to large central computers in order to access central data bases or to act as terminals. Small businesses will own a single computer that will host several applications: address list maintenance and label generation, text editing, accounting, payroll, and inventory control.

Personal computers will have a dramatic impact on computer science education. Elementary and secondary schools that could not afford computer access now find the economics radically changing. They can all afford a computer. The limiting factors will now be the supply of trained teachers and the ease of use of the personal computing systems provided for educational purposes. Additionally, personal computers will broaden the use of computer-assisted instruction not only in educational institutions but in the home as well.

Personal computing research includes research into computers for, and computing by, individuals. Most traditional hardware and software research areas are included, but with a new ground rule: computers no longer need be dedicated to an individual or application. Areas of particular interest include computer hardware and software architectures for personal computers, net-

Editorial Conference

working of personal computers, programming languages for personal computers, and user-interface design for home computing applications. Many new research opportunities are related to applications of the personal computer in environments ranging from the home to elementary schools to offices. In fact, the very intriguing general question of the impact of abundant, low-cost information processing power upon our social fabric is one that needs considerable thought.

Personal computing product development is the important emerging technology that concerns itself with creating the hardware and software products suitable for the personal computing market. Products include computers, peripherals, systems software, and application software. There are significant departures in the ground rules used to design these products from those used to design these products from those used to design more traditional computer products. The cost must be low, standards are very important, the user interface should be simple, and the hardware will be, for the most part, maintained by a computer store.

Figure 1. Personal Computing

Home computing is the term given to uses of computers in the home: accounting, financial planning, computer-assisted instruction, educational and recreational games, and a myriad of other uses. Soon the users of home computers will include those who do not even know how to program. Rather, they will use application packages developed by others. We probably won't even think of these computers-plus-application-software as computers, but rather as appliances that solve particular problems. For example, the Home Business System Appliance would come to our home ready to do our accounting and financial planning. Today's video game is a perfect example. The more sophisticated video games are computer-based. The next generation of video games will use keyboard input, be computer-based, and run very sophisticated software to play such nontrivial games as space war and chess. There is probably a far greater market for this type of home appliance than there will ever be for computers that will be programmed in the home.

Admittedly, some of the areas into which we have divided personal computing are overlapping. For example, using a home computer to analyze the stock market is somewhere between home computing and business uses of personal computers. Elsewhere, computer hobbyists may be exploring technical problems that are normally studied only by professional researchers. Even so, Figure 1 constitutes a useful breakdown.

What should be the relationship of the computing professional societies, such as the IEEE Computer Society, to personal computing? Based on the preceding discussion, the answer — at least in terms of some facets of personal computing — is plain. Personal computing research, personal computing product development, business uses of personal computers and educational uses of personal computers clearly fall within the interests of our several professional societies. Home computing and hobby computing require further discussion.

The question of the relationship of home computing to our professional societies is a simple one. The home computer, as discussed earlier, will come complete with application software and be regarded by most as another home appliance. Such a user no more belongs in our computer professional societies than do television viewers in professional associations for television design engineers.

Although most people agree there are differences, the computer hobbyist and the computer professional cannot be easily distinguished. Pragmatically speaking, one might say that a computer professional is one whose income is derived from the practice of the art and science of computing. On the other hand, a hobbyist does not derive income from the practice of his hobby. On many fronts the interests of the hobbyist and the professional are the same including technical areas, exchange of information, and advancement of computing science. There will also be significant movement of people from the computer hobby to the computing profession. And we must not overlook the fact that many computer professionals are also hobbyists.

A major goal of professional societies is to promote the free exchange of information about computing. Certainly hobbyists are interested in both contributing to and benefitting from such information exchange. One need only look at the flurry of publications in the computer hobby area to be convinced of this fact. The publications of our professional societies strive to serve the beginner, the researcher, and the practitioner. Certainly much of the material in our professional publications is of interest to computer hobbyists. On the other hand, many educators are discovering that the material being published in computer hobby magazines is very useful in computer science education — filling a need for introductory level material that has not been met by the professional societies.

Another major goal of our professional societies is the advancement of computing science. Certainly, the hobbyists are contributing to this goal. With computing resources now readily accessible, computer hardware and software inventions will no longer come exclusively from the universities, corporation, and government that can afford large expensive computers.

How can the hobbyist and the professionals cooperate to take advantage of their overlapping interests? Two ways seem apparent. First, provisions might be made for the hobbyists to join a professional society as a non-voting member in order to receive publications, attend conferences, etc. Second, the sure-to-be-formed hobbyist society could cooperate with the current professional societies on topics, projects, and conferences of mutual concern. □

Things To Come

By David Ahl
Publisher of CREATIVE COMPUTING

Creative Computing is a magazine dedicated to providing innovative, pragmatic applications for personal, educational and small business computers.

Over the next five years I expect dramatic changes in every aspect of the small computer field. Those of us now in the field will be overwhelmed, at least in numbers, by people today who have never heard of a personal computer. This is somewhat akin to the situation in 1920 when radio amateurs, who had for years been a growing but close-knit group, all of a sudden, with the advent of commercial AM radio, found themselves in a minority of radio users. Companies who had been catering to hams switched over to production of commercial radios as a new consumer industry leaped into life. Oh sure, some manufacturers stuck with the hams and over the years there were new entrants, but the real growth was in commercial radio.

After all, they're buying their computer for one or more specific purposes, not for the fun of building it . . . or any of the other reasons that most people have bought their own computers for the past three years.

Today, the TRS-80, PET, VideoBrain, and Atari Video Computer System are the first of what promises to be a broad, expanding line of commercial personal computers. More and more, the video game systems will have keyboard and memory options and new computers will be announced at the Toy Fair or Consumer Electronics Show rather than at computer industry shows. How often have you seen Atari or Coleco at a personal computing show or the NCC? Yet it is from companies like these that I expect major future developments. (This is one reason that at *Creative Computing* we cover these "other" shows and product profiles of video games and the like.)

A parallel development to the completey assembled, neatly packaged commercial computer system will be systems dedicated to a single function or group of functions. For example, no longer will you buy *one* general purpose computer, but you will buy one for text editing, one for library cataloging, one for games, one for music synthesis, one for CAI, and so on. As prices come down to $300 and lower, it just won't make sense to buy the peripherals to do all these functions on one system when several dedicated, individual systems can be bought for the same or less cost.

The user, of course, will not have to learn to program in BASIC or other computer language since all the systems and applications software will be built in. Computer clubs, therefore will lose one of their primary functions of software interchange. Indeed, the typical buyer of a commercial personal computer, like buyers of AM radios in the 1920's, will have little interest in a computer club anyway. After all, they're buying their computer for one or more specific purposes, not for the fun of building it, or writing software, or any of the other reasons that most people have bought their own computers for the past three years. □

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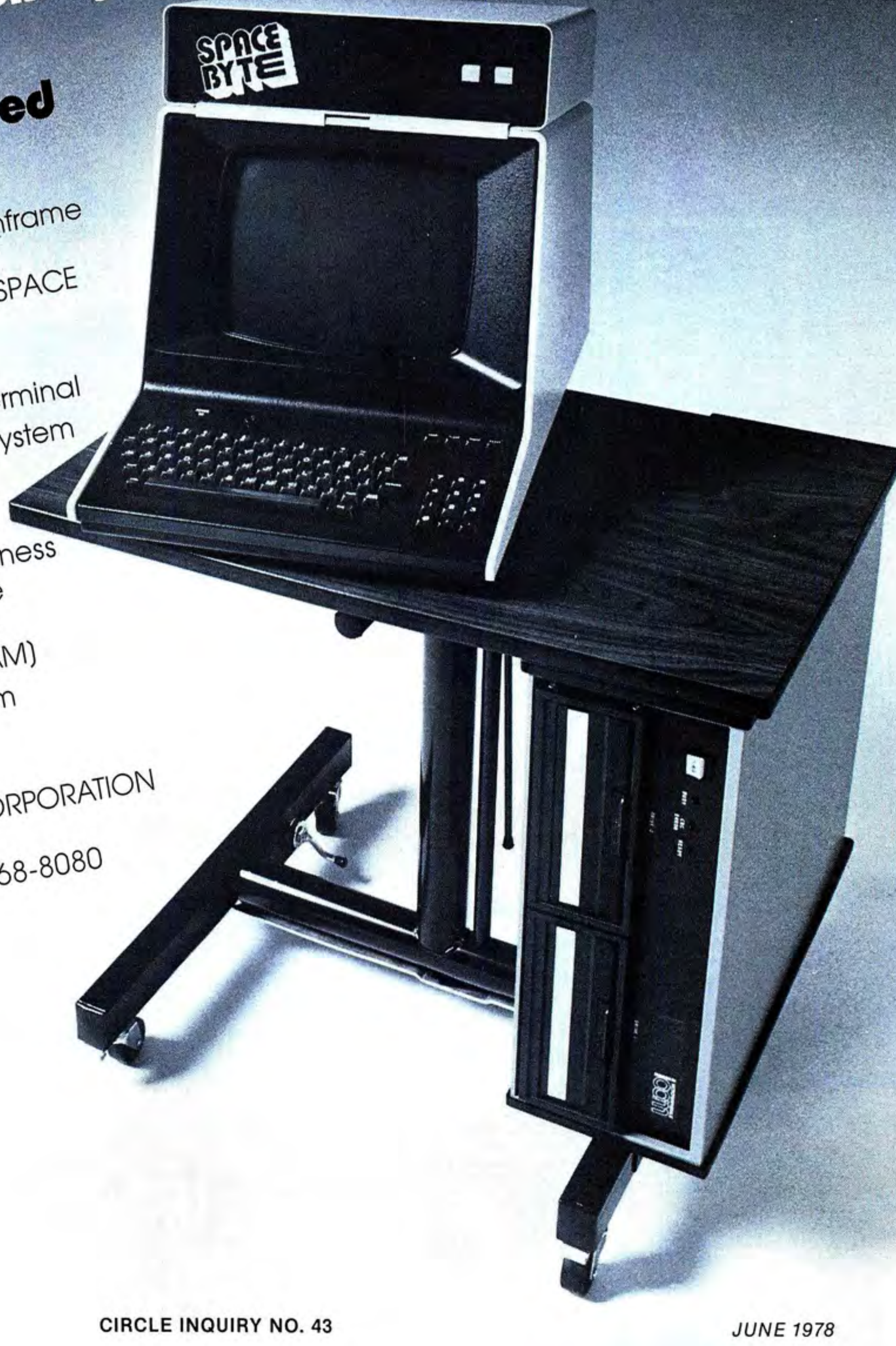

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Another parallel development that will profoundly influence the use of small computers will be the establishment of one or more low-cost digital communication networks. The recently-announced Bell Data Network (ACS) may be overkill for home users but no matter what the form, home and small business users will have access to high-speed data communications. Not only will users have access to data bases containing all types of encyclopedic data, stock market data, and the like, but also the small business will be able to receive orders from field sales representatives, acknowledge orders, quote prices, and perform all the other data communications functions now available only to larger business with their own data nets.

In forecasting all this, I don't mean to imply that the current cult of personal computer users will die out. Quite the contrary, they will continue to exist just as radio amateurs did. Some will gravitate toward packaged commercial systems while others will continue in computing as a hobby. There will be side-by-side development between hobbyists and packaged systems users, some overlap and much synergy. All in all, the future of small computing will continue to be intellectually challenging and exhilarating, it will expand at an increasing pace, and in ten years most people will regard a personal computer as commonplace as a transistor radio or pocket calculator today.

We at *Creative Computing* intend to be there too, growing and changing with the field. We hope you'll be with us.□

The Personal Computer and Change In The Computer Industry

By Portia Isaacson, Ph.D.
Contributing Editor, DATAMATION

Datamation is considered by many to be the leading publication serving the large mainframe field. However, Datamation covers the entire computer industry including microcomputer advances and applications.

The computer industry and the computer professional will experience substantial changes in the new era of abundant computing. As the demand for small computers goes up, the demand for large centralized computers will come down. It will often be found that new applications, or portions of new applications, are more economical on small computers. The traditional corporate demand for bigger and bigger computers will slacken as fewer new applications are developed for it. Additionally, time-sharing use of the big corporate computer will be replaced by small computers in instances that are not locked in by data bases or applications software.

The corporate data processing center will lose control of the data processing function as more and more departments own their own computers. The DP center will do less new development since new projects will be done at the departmental level if possible. The DP center may find a new role when departments realize that they want to access the central data base and communicate with the computers of other departments. DP's new role will be in planning the distributed data base and communication networks. This role will not be easy since departments will realize that information is power struggle between departments with DP caught in the middle.

Now that computers can be owned by individuals or dedicated to the use of an individual in a corporation, there is little need for time-sharing. In fact, time-sharing was invented as an attempt to give the illusion that each user had his or her own computer. Now that each user can have his or her own computer, time-sharing is no

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longer needed and the overhead required by sharing makes it uncompetitive. Present time-sharing customers will, of course, stay with time-sharing if they are locked in by software or data bases. Additionally, there are a few applications that may need resources too great for today's small computer.

A complex software package may sell for just a few dollars because it will be sold thousands of times.

The big computer will not go down without a fight. We can expect to see significant price cuts in order to keep the gargantuan machine alive. But ultimately the giants will be kept only to run programs too hard to change. Most new architectures will be based on unshared computers, shared large disks, and shared fast peripherals connected into networks. The heyday of distributed computing will have arrived.

The new computer industry will see many opportunities. Computer manufacturing and distribution will be feasible small businesses. The new small companies with low overhead will keep the price of computing low; and, in fact, may provide the solution to the problem of the present near-monopoly in the industry. There will be a new economics associated with mass produced software. A complex software package may sell for just a few dollars because it will be sold thousands of times. Individuals may be able to capitalize on their efforts in software creation through royalty payments in much the same way as authors of books do now.

The data processing professional will be faced with many changes. The data processing department will need maintenance programmers, communications and network experts, and data base designers. Programing will be done in user departments where application knowledge will be at a premium. So programmers who don't fit into the new DP department will find themselves in user departments specializing in a particular application area. This specialization will certainly limit their mobility.

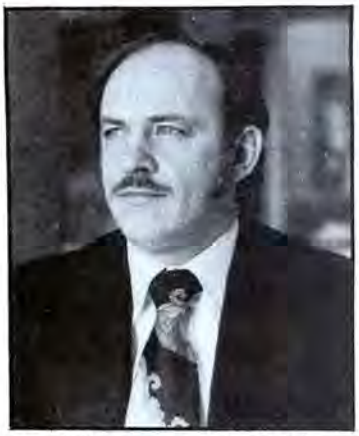
Although lower-cost computers will mean more computers and a great demand for programmers, the greater demand will be offset by a greatly increased supply of entry-level programmers and the fact that programming will be easier. Schools at all levels will be able to offer computer training since the hardware is now affordable. Many people will even teach themselves how to program. The new small computers are interactive and much easier to program than big batch computers. All this could lead to a decrease in the salary level of entry-level programmers. Ultimately this must affect other levels.

As the public becomes more and more knowledgeable about computers, the job of the data processing professional will seem much less glamorous and mysterious and much more just an ordinary job. This will have more than just an ego deflating effect on the profession. A computer-literate public will demand that the programming job be done properly with the good of the public an objective. We can expect to see a public demand for legislation to control usage and programmer qualifications. As the public becomes more aware that they are becoming increasingly dependent on unproven computer technology, our profession may find itself in the fish bowl of public controversy. ☐

The Microcomputer
A Revolution in Automatic Control

By N.C. Persson
Associate Editor, DESIGN NEWS

Design News, as its name implies, is a magazine that reports on design technology. The magazine covers the design field from microcomputers to thermal analog timers. The magazine is primarily for design engineers who are looking for ideas to solve design problems.



The microcomputer is at once the most exciting and most frustrating technological advance of this age, and perhaps any age since the dawn of civilization. Exciting, because as many sages have observed,the small size, low cost, and small power needs of these devices place the power of computing within reach of the average individual, and because it provides science and industry with a minuscule device that can be incorporated into a numberless array of products and processes to provide inexpensive *programmable* control.

It is frustrating, because the unsuspecting individual who attempts to learn about these wonderful devices soon learns, much to his dismay, that a really thorough knowledge of how they function and how to use them would require the equivalent of degrees in electronic engineering and computer science.

We have seen, however, that this thorough understanding of the microcomputer is not essential to use it, and people are increasingly making the investment in both time and money to avail themselves of the power of microcomputers.

Design News recognizes the importance of microcomputers in all of their aspects. Because our audience is comprised primarily of mechanical engineers in the original equipment manufacturing area, however, the primary thrust of our editorial is the microcomputer as a logic element, or control device, in products and processes. As such the microcomputer is having an impact on manufacturing that is unprecedented. All manner of products — automobiles, appliances, toys and games and hundreds of others — either already feature or will feature microprocessors to control some or all functions.

As early as January 1975 *Design News* recognized the impact that microcomputers were having and would have. The January 20, 1975 issue carried an article "Microprocessors: Looking Ahead" in which Lars Soderholm, Editorial Director, referring to a research study, stated: "These figures are of profound significance to the design engineer. To his benefit is the fact that higher product volumes and higher circuit densities have caused the price of microprocessors and microcomputers to drop substantially. But the end isn't in sight. As costs continue to go down, the designer can let the microprocessor take over a wide variety of arithmetic and logic functions in the equipment and systems he designs. Because of the small size of the units, the design engineer can incorporate dedicated control systems as part of his product or process systems."

Developments since that time have amply confirmed that prediction, and many of those developments have been reported in *Design News*.

It seems safe to say at this time that no one, not even those at the forefront of this technology, has yet fully grasped the implications to society of the computer on a chip, and that the prognostications, to date, of its impact may one day appear conservative compared to the unfolding of actual events. Who, for example, at the time of the industrial revolution, could have foreseen the world of today which that revolution made possible: nearly everyone the master of electrically operated servants that take much of the drudgery out of the chores of everyday living, motor-driven chariots that reduce what was once a day's travel to less than an hour, and aircraft that span the globe in a day. The effects of the microcomputer revolution, while of a different nature, should be no less far reaching.

...the sheer complexity of the device, and seemingly limitless applications, require that publications ...strive to present thorough coverage of these devices, within their stated scope.

The microcomputer as a control device is already having a profound effect on our lives, and this influence will no doubt intensify as more and more applications yield to microcomputer control. Right now portions of the emission control systems of selected automobiles coming out of Detroit are under microprocessor control, and within a few years microcomputer control of automobile functions will increase tremendously. A few appliances — washers, dryers, microwave ovens — are now being produced with microcomputer-based controls, and once again, this trend cannot but accelerate.

Many products are being produced with enhanced features because of microcomputers, for example: a bicycle exerciser that not only provides exercise but monitors the user's heart rate and blood pressure, and, based upon the user's sex, age and weight provides an analysis of the "health factor" of the exercise performed.

Every day new microcomputer-based systems are announced: intelligent instruments, intelligent terminals, intelligent keyboards, data acquisition systems, sophisticated controllers; every manner of product to which microcomputers can lend their unique computing and control capabilities.

And the microcomputer is less than a decade old!

But industry has discovered it, immediately recognized its vast potential, and is struggling to learn more about it, to exploit that great potential.

The task of magazines such as those represented here is clear. Education! Whether the microcomputer is considered primarily as a computing device that has given the power of computing to everyone, or as an inexpensive, high capability control device, the sheer complexity of the device, and seemingly limitless applications, require that publications that would serve users and potential users strive to present thorough coverage of these devices, within their stated scope, from device construction and operation to current and future applications.

This type of conscientious publishing will go a long way toward easing the future shock already engendered by the unfolding microcomputer revolution and hasten the integration of the microcomputer into society. □

You Mean My Fallacy Is Incorrect?

By Dennis Hamilton
Editor, INTERNATIONAL COMPUTER PROGRAMS, INC.

International Computer Programs, Inc. is an Indianapolis-based publisher of proprietary software periodicals. Included among them are the ***ICP Software Directory,*** *the* ***ICP Mini-Small Business Systems Directory*** *(which between them list and describe more than 5,000 available software products) and the* ***ICP INTERFACE Series,*** *six industry-oriented software magazines. ICP, now in its twelfth year, reaches more than 160,000 software buyers throughout the world.*

Marshall McLuhan, the venerable and ethereal academician-*cum*-philosopher, was discoursing at the recent Data 78 conference in Toronto, Ontario. In the midst of one of his cerebral jogs, he alluded to his cameo appearance in Woody Allen's *Annie Hall.* Allen queried McLuhan as to the validity of one of his immortal pronouncements, whereupon McLuhan replied: "You mean my fallacy is incorrect?" At which point McLuhan proceeded to apply his non sequitur to many of the computer industry's founding premises. Make no mistake about it — it applies.

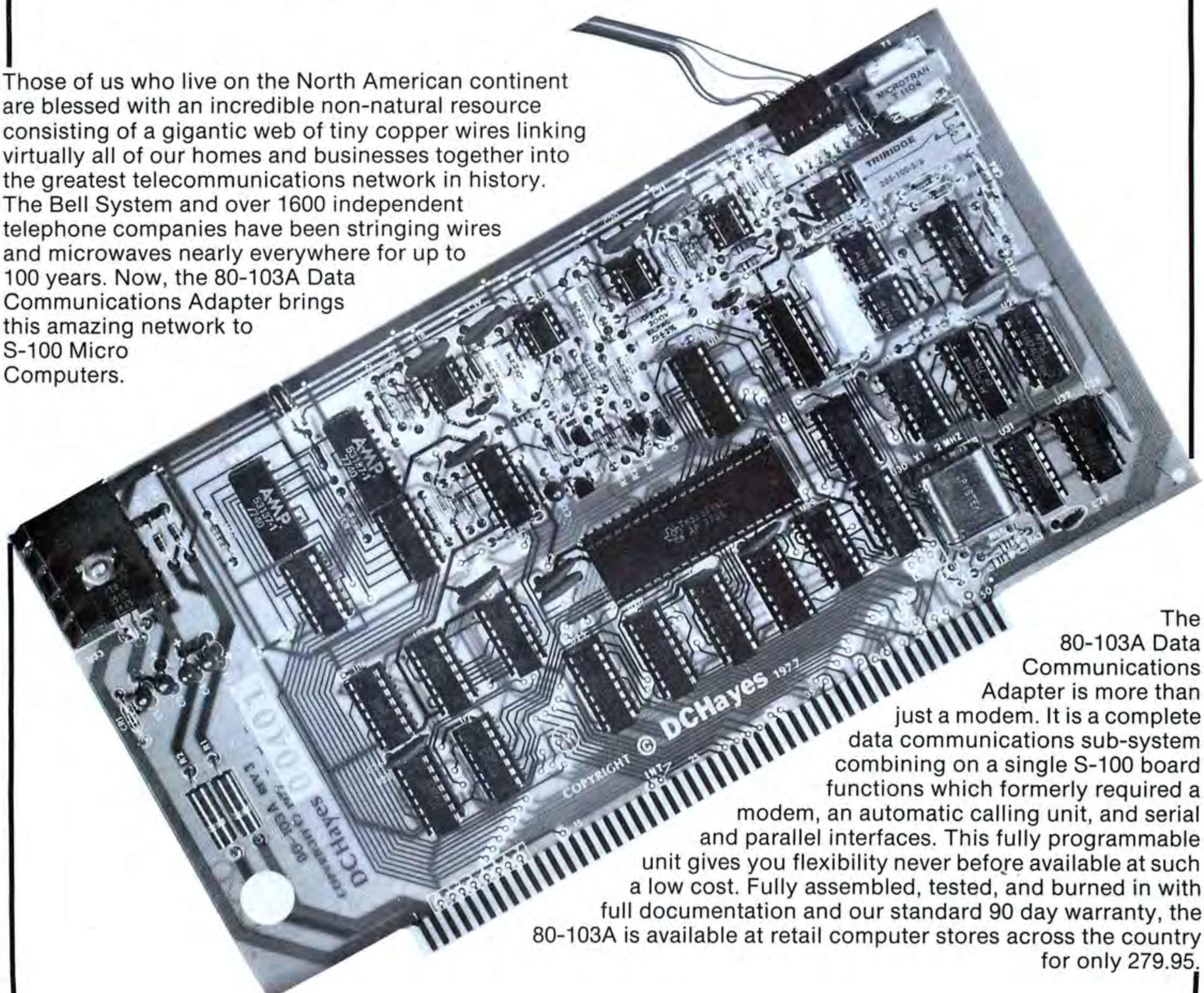
The most difficult fallacies to dispel are those that have not always been fallacious. Just as the brothers Wright, Orville and Wilbur, were christened loonies for trying to shatter the tenured belief that man couldn't fly, such is the resistance to contemporary icon-busting. That man couldn't fly hadn't always *been* fallacious; a new truth had simply evolved. As in the saga of airborne man, truths also evolve in the computer industry; and fallacies that once weren't, suddenly are.

The fallacy up for interment today deals with priorities in computer "system" acquisition. Ever since ENIAC — Electronic Numerical Integrator and Computer — got its 30 tons of material, its 18,000 vacuum tubes and its 55 operators together back in '46 to get a toe in the door to the electronic computer era, software has been an afterthought. At the outset of the era, and for roughly the next two decades, that was a necessary priority. First the hardware, then the software. Simplistically, this was because one needed the hardware in order to *develop* the software. Considering its incredible worth, it took an inordinate amount of time before the concept of "packaged software" caught on. Given birth in the mid-'60's, the software industry — for large and medium-scale equipment — struggled along with the rest of us through that turbulent decade. When the Not-Invented-Here (NIH) syndrome wasn't tripping up its progress, the mainframers' policy of bundling hardware and software prices together served as an apt deterrent to its growth.

The '70's, conversely, has proved a decade of a different color. IBM kicked it off nicely by unbundling, which meant that users could shop for software. Escalating software costs, coupled with the growing sophistication of proprietary software companies, has understandably eroded the deleterious effects of NIH. Pack-

modem / 'mo • dəm / [**mod**ulator + **dem**odulator] *n - s* : a device for transmission of digital information via an analog channel such as a telephone circuit.

Those of us who live on the North American continent are blessed with an incredible non-natural resource consisting of a gigantic web of tiny copper wires linking virtually all of our homes and businesses together into the greatest telecommunications network in history. The Bell System and over 1600 independent telephone companies have been stringing wires and microwaves nearly everywhere for up to 100 years. Now, the 80-103A Data Communications Adapter brings this amazing network to S-100 Micro Computers.



The 80-103A Data Communications Adapter is more than just a modem. It is a complete data communications sub-system combining on a single S-100 board functions which formerly required a modem, an automatic calling unit, and serial and parallel interfaces. This fully programmable unit gives you flexibility never before available at such a low cost. Fully assembled, tested, and burned in with full documentation and our standard 90 day warranty, the 80-103A is available at retail computer stores across the country for only 279.95.

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ages, rule of thumb, can generally be purchased for one-tenth the cost of developing them; and they can be up-and-running in about one-fiftieth the time.

Today, the software industry is precisely that — a near billion-dollar marketplace, and that's not even counting IBM's estimated $400-$600 million in per annum software revenues. But the vast majority of these revenues derive from the large and medium-scale computer markets. The proprietary software market for minicomputers and microcomputers, both for personal and corporate use, is just beginning to flower. Whether it flowers quickly or its blossoms have to be pried open is largely contingent on whether mini and micro users are willing to learn from the mistakes of their mainframe siblings.

One truth that has evolved is that the computer is merely a jumble of lifeless circuits and unfulfilled promise until someone loads in its "mind" — the software. Which brings up the question of which element is the most important: the hard or the soft?

Mainframe users spent nearly a quarter of a century fretting over which hunk of iron to buy, then worrying about the software as an afterthought. But there's now a school of thought, enrollment in which is substantial and growing, that says: Define your needs and objectives; find the software that meets them; then find the hardware that will mate with the software.

It's evident by scanning such journals as *INTERFACE AGE, Dr. Dobbs, Personal Computing, Byte,* etc., that there is a wealth of available software for the micro market. With this resource, is it more sane to plunk down a bankroll for a glittering piece of equipment and then worry about whether there is software for it even remotely capable of meeting your requirements (often to discover there isn't)?

Logic dictates that software be the cornerstone on which the "system" is built. This helps avoid situations such as when a fellow bought a mainframe the software for which didn't have interfaces for his numerous remote terminals. He could process information 20% faster — only to find he had to distribute it on trucks.

Regardless of whether a system is being bought or built, its software should endure as the focal point. There should never be upgrades, downgrades or wholesale switches disregarding the impact on the system's programs. And if the system is new, has yet to take shape, define your requirements and the software that addresses them at the start. There will likely be a variety of nifty computers from which to choose to complete the equation. And the end result will be a "system" that does what it was designed to do. That's the truth that has evolved. □

Cooperation

By John Craig
Editor, KILOBAUD

Kilobaud is aimed toward the reader without previous computer background, programmers without hardware knowledge, or engineers without experience in software design. It is understandable for beginners, interesting for experts.

I have a lot of friends within the personal computing field. . . and I certainly count Carl Warren and Bob Jones among them. I first met Bob at the MITS Altair Convention in Albuquerque in March of 1976. He made a statement during that initial meeting which left quite an impression — and has been something I've tried to live by. He said, "If we all work together at this thing, John, then we're all going to be successful together." Sounds beautiful, doesn't it? Better yet, *it works beautifully.*

There's a lot more to this cooperation thing than just the magazines working together (which I'll get into in just a moment). This industry is made of many, many companies, both large and small. Most of the manufacturers distribute their products through computer stores and if there was ever a situation which cried out for cooperation, this is it. Most of the dealers I've talked to have all had one thing in common; a feeling that they're "going it alone" as far as selling most manufacturers' products. The support is practically nonexistent in almost every case. And what kind of support are we talking about? Mostly little things, like trying to be honest and up-front about delivery delays, answering technical questions on the phone or by mail, sending out hardware and software updates and just generally being helpful.

One of my primary goals in life is to get as many people as I possibly can turned on to personal computers (in small business, home and educational environments).

A handful of companies have recently added Manufacturer Representatives to their staffs, with a resulting increase in helpfulness and interaction with dealers. These people travel around to various stores and outlets selling the company's products — and the company. I've heard only good stories about this approach.

Why is any of this important? Well, it's important to me because I want to see this industry survive and grow and become very successful — and strong. One of my primary goals in life is to get an many people as I possibly can turned on to personal computers (in small business, home and educational environments). Because of this, I sometimes sit around and write editorials with all this free advice on how others can help me achieve that goal.

Speaking of free advice, let me toss out a little bit to some of the smaller companies and how they can help themselves when interacting with the magazines. I personally enjoy running new product announcements for any size company, especially when it's an exciting product. However, I get a particular kick out of helping newer, smaller companies this way because it may be the only advertising they can initially afford (i.e., free). It's absolutely amazing how some of these small companies can go through the design and development of a product and then totally drop the ball when it comes to marketing it. I (and every other editor in the field) have received too many new product announcements that have been typed up on some clunky old typewriter, complete with overstrikes and misspelled words. In addition, the photograph accompanying the announcement is either unusable or nonexistent. Okay, so here's the free advice. If you can't generate a professional appearing and usable product announcement yourself then get busy and find the people who can. It may spell the difference between success and failure.

As a concluding note on this cooperation theme, I'm certainly hopeful that we'll see more and more of it between the magazines in the personal computing field. . . and there sure are a bunch of 'em, aren't there? It really does my heart good to see all of the magazines get behind a worthwhile event and push and promote it. The same holds true for a new idea or technique, standards and even *writing guest editorials.*

I enjoyed this short visit to the pages of INTERFACE AGE, and hope I get invited back again someday. Best to all of you. □

A Feasting of Thoughts, A Banqueting of Words

An Article on the Theatre of the Future

By Ray Bradbury

I imagine a room with forty men and women seated with alternately empty chairs between, 80 chairs in all, but only 40 occupied. It is a robot's banquet in the year 1999, and I have been invited.

I enter and am greeted with a chorus of voices. The men and women at the tables raise their glasses to me and call out.

Here, no here, here, no here, here!

And I sit now with Plato, now with Aristotle, now with Emily Dickinson, in a great feasting of thoughts, and a banqueting of words.

"Dear Mr. Bradbury!"

Plato seizes my hand briskly.

"Sir," I say, "How goes it with your Republic?"

"Superb! Fine! Well, almost—"

"What seems to be the problem, sir?"

"The problem runs so—"

And he tells me. And I listen.

And I rise and change seats and speak to Sara Teasdale or Sir Beerbohm Tree. And I rise and go now with William Butler Yeats. Or I take tiffin with Shakespeare and he gives me Richard's first dark speech. So I move around the endless table, breaking my fast with splendid words, meeting and basking with talented people reborn in robots to outlast time.

All this, theatre of the Future?

Yes, or one variety thereof.

What other shape will Future Theatre take?

Will it be truly new and exciting and alive? Will people swarm to it as they once swarmed, wild bees in need of pontifical/political/aesthetic honey?

Will multi-media grab it all and own it?

Will theatre vanish into the darkness behind the silver-screen only to re-appear with larger vocal cords, bigger ears, wider body, vaster significance?

In other words, will everything become one big hard Rock festival, super-radio, Cinerama-TV Long Playing Cinema?

Or can the quiet voice well-articulated, small idea well ventilated, single actor well-educated and speaking very much alone and softly, prevail?

It is too early on in the 21st Century to say.

One can guess, but one cannot truly tell.

I have guessed at the influence of holograms on our lives, in one instance.

By the sheerest of accidents I ran across some old friends several years ago as they were on their way to someone's apartment, there to be visited by 'Ghosts.'

Which is to say three-dimensional images tossed forth on the air before, or rather in, one's eyeballs, shot there by the expert marksmanship of a laser-beam projector.

With my first view of these hologramic ghosts, I thought, my God, how wonderful to come back once every fifty years for the next ten thousand years to see what we'll be up to in the Arts, turning ourselves inside out, upside-down, wrongside-to with light, color, sound, and the speaking of as-of-now unspeakable tongues! Lord give me that gift. Let me come back, let me hear and see and know!

In the year 2035, not so far off across the sill, I imagined a typical home where, white or cocoa-tinted (which will be very IN that year) men, women, and children, will exercise rather than exorcise their 'Ghosts.'

The son summons up the Hound of The Baskervilles which lurks in the shadows of his bedroom. It bounds forth, projected in three dimensions, by a laser-beam photo 'emanator' hidden in his ceiling.

Simultaneously, the daughter calls for and is answered by Kathie who rushes in a storm of snow, across her living quarters floor to vanish in the cold hills of WUTHERING HEIGHTS.

The father speaks to and is answered by Hamlet's Father's Ghost who rises in battlements and speaks memory and prophecy in one intonation.

The mother, kitchen-bound, is instructed by a hologram three-dimensional Cooking Witch who appears in clouds of steam but to vanish in mists of spice.

Late at night, each person, attended by their own laser-ghost, beds down, touches panel-button and sees first the Hound sink into the long grass of the Moor, then Kathie lost in storms, dwindling into the nap of the run, then Hamlet's Father turned to a mist within a mist, and the Cooking Witch with a last steam-kettle sigh, jackstraw heaping herself in a corner to melt, gone, all gone, and the time of sleep come.

Theatre. Not just in a large house on a vast stage, but whispering at your ear, jiggling your elbow and your subconscious. Robot mosquitoes sizzling about your head as if it were a cider-jug, repeating Pasts, advising Futures.

Theatre.

What other ways will it walk in the years ahead?

During the past few months I have helped organize a Theatre of Philosophy course at Santa Ana College. Within the classroom context, and occasionally using a semi-theatre, we have begun plans to stage what was always a stage piece from the beginning: Plato's Republic. Burgess Meredith appeared to dramatize sections of the books of Don Juan by *Castenada*. I took off and flew around a bit with Kazantzakis' religious/philosophical explosion, THE SAVIOURS OF GOD. For the Future, the possibility of staging Shaw's play Prefaces, with not just one but why not two Shaws on stage? Played by two actors engaged in verbal colics and amiable deliriums? Shaws I and II I call it, and I have finished a manuscript on this with Shaw Positive and Shaw Negative filling an evening with his Prefaces, his Musical Criticisms, his sometime despairs at Mankind, and his hopes for the Life Force and mouth-to-mouth breathing the Universe to survive.

What else up ahead?

Robot theatres of history. Rooms into which you walk to see humanoid machines seated under trees on a summer afternoon and walk over to sit with them and say, "Caesar, how go the Roman roads through Britain?" And he'll show you. And: "Euripedes and Aristotle, how *does* one write a play, a poem?"

And *they* tell you.

And you then trade wisdoms, your *large* one for their small ones, eh? And they treat you as a crony, as one of their bright crowd, which makes you grow and grow and grow.

What a wine-press to lovingly crush a student in. Aristotle's shoulder to one side, Euripedes to the other, and — *smunch!* you're educated by yammer and blab and gab.

Well, say you, since you speak of Future Theatre, what have you, sir, done about it? Your plans, your ideas, your plays?

I toss my baggage in and travel with Shaw, who, I would like to think, might be amused at the company. The theatre of Ideas is my meat and drink, but, one hopes, without being ecclesiastical, without pontificating or browbeating. If an idea doesn't surprise people and win them by passionate and entertaining means, you had best give up and go find a soapbox and install yourself on a street corner.

I have begun to write a series of plays about that future which is no further off than one minute after midnight tonight. If we are to live in space for the next two billion years, give or take a million, then we must have reasons for doing so.

The propaganda for such theatre can exist in many

forms. I began my first experiments with this when the United States Pavilion people at the New York World's Fair in 1954-55 asked me to create a ride in the top of the building. Circuiting the darkness on a traveling platform, 500 years of American history 'happened' to the viewers wending their way through 110 cinema screens of all sizes and shapes, accompanied by a narrator and a full symphony orchestra. It was my job to tell us what we were, what we are, and what we can hope to be. We were, I said, the people of the triple Wilderness, who crossed a Wilderness of sea to come here, a Wilderness of grass to stay here, and now, late in time, move toward a Wilderness of Stars to live forever.

The metaphor worked. At the conclusion of our theatrical excursion, a thousand rocket ships took off in a furnace of fire to move toward Alpha Centauri and beyond, surrounding the audience with the passion and desire for flight and, hopefully, for the genetic survival of mankind at the end of that flight.

Theatre? Of course it was. A variation of same. Even more theatrical was the enterprise that took me out to the WED ENTERPRISES building in Glendale. The Disney Robot Factory, is what *I* call it, if they will forgive me.

The WED building has no name or number on it. It is a plain looking building inside which gigantic miraculous snowflakes are built and launched, dinosaurs come alive, Presidents from Washington to Ford are built and slapped on the back to make them cough forth miracles of grandiloquent cliche.

My job there in theatre? Was to seize a few dozen audio-animatronic robot humanoid creatures and fashion a 5 billion year history of Earth coming out of the sun, cooling and bringing forth in its seas the animalcules that would one day shape spines and stride in teeming apecrews of men, women, and children, using fire along the way.

I had Michelangelo spring feverishly from the platform pit as artist magician, a robot who pointed over the audience's heads and ordered the ceilings to change. Then I blueprinted the hidden and miraculous machineries of this extraordinary theatre to paint, before their uplifted gaze, the Sistine Chapel ceiling and walls over and around and above them. In two minutes flat they would experience what it took Michelangelo hundreds of days to paint.

Super-theatre. Wouldn't you, wouldn't I, like to be in a theatre where we could see *that* happen every day, or perhaps every year of our life?

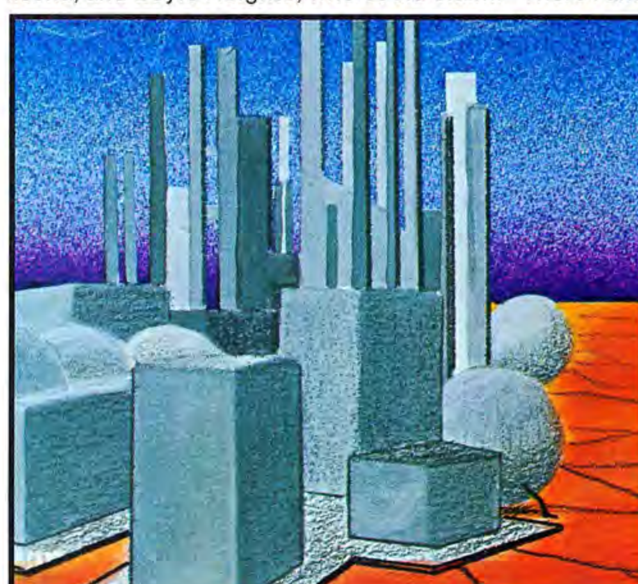
For this experience, acted out by robots, accompanied by orchestras and voices, I imagined apemen robots who, before your eyes, turned into Egyptian priests, then divested themselves to become DaVinci among his fabled machines, Ben Franklin struck to ashes by lightning, the Wright Brothers, goggled and elated on Kitty Hawk sand-dunes, and finally a man of the future, X-rayed, in whose body we might see the destiny of man. For super-photographed, shot through with probing light, each of us in our cells and molecules, is the sun energy we eat and drink each day. In every drop of blood a million small bits of sun burn. Silhouetting a family of the future, I packed their bodies full with ten billion small suns so that the audience would see a true metaphor: we are creatures that came out of the Sun long long ago, have lived by the sun and its energy hidden in foods, broken down to light and power in our flesh. And now we move up in space toward far suns to survive in their strange light and go on being solar creatures forever.

Again — super-theatre, this time with robots.

The machines described above could be used to turn classrooms into theatres of knowledge. The walls of future classrooms should be transparent so that environments could be projected on same. Each day when the class arrived, they would find themselves surrounded on Monday by Delhi, Tuesday by Johannesburg, Wednesday by Pittsburgh and its Hell, Thursday and Friday by Rio or some land that time forgot, filled with brontosaurs, two million years lost.

Or again, participatory theatre extended in new directions. Come back in 40 years or less and you might well find film labs offering major pictures in which you yourself might appear. The leading roles in certain special electronically treated films would be shadowed out, untouched, undeveloped. You in your own home could then measure out a similar space in your own parlor, pace out the performance, act, speak, and photograph yourself so that your image would be superimposed on the film opposite a 21st Century Olivier, Burton, or God help us all, Burt Reynolds. If your performance was poor the film could be stripped of your image by running it through an eraser, and you start over.

Or you could cross-pollinate performances with friends across the world, you doing your performance in Los Angeles on one-half of a film-image, mailing it off to Paris, where some 22nd Century Barrault would glue his image to the other half. The variations on this would be infinite. Great actor-teachers across the world could, by electronic tape, offer their instructive services by sharing such films with wild young Thespians in Timbuctoo, Waukesha, and Boyle Heights, who could claim: "There I am,



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CIRCLE INQUIRY NO. 25

there's Barrymore, aren't *I* great?" even if it wasn't true!

But in the midst of this electronic bombardment, you ask somewhat irritably, what about little theatre, small theatre within the larger fencings.

The means may be new but the message stays on as it was when we trembled at mouths of caves and invented fire: Lost loves . . .lost lives, and the strange small gain that we name wisdom and warm our hands in the ridiculous night.

But, of course, no matter how large the multi-media, or how complex the stage of 21st Century houses, the single actor in the lone spotlight will still be the thing.

As more small towns are rebirthed across America, and they will be rebirthed, for we need them as multitudinous navels, otherwise we shall unravel in manic fits, will be rebirthed the ancient concept of the college-theatre-small town. If we make certain that all the arts are built into the electronic units that those towns in many ways will be, we can keep 'em down on the farm, to change the direction of that old song. Kids once left home for the big city because everything, meaning the arts and action, collisions of people, and sex, was there.

Between now and 1999 three hundred such small college towns, with simple, uncomplicated directly staged theatre must and will be built, embodying by blueprint and dream, the things that cities once were or pretended to be before they, shot like mammoths, fell down dead.

In those new small green villages, the old poet speaker and teller of tales will be reborn of late afternoons to speak through dusk unto midnight.

I could go on for another ten thousand words, but —

We end as we began, back in that huge banquet room with every other chair empty and every other chair propped with genius, aglow with wit, trembling with the energy of the robot man or woman placed therein.

I sit me down by robot Shaw. I shut my trap. He speaks my finale:

"Theatre in the Future? How tiresome, how obvious, how easy! It will have a thousand shapes and sizes, like those shadows on old Plato's cavern wall, the shades of realities guessed at and half-seen. Battery-assisted, electronically produced, technologically enhanced, it will still be the poet's province and the human's kennel if they dare to sing or most happily bark. It will still be one actor speaking to one listener, no matter how many seem to be eavesdropping in. The means may be new but the message stays on as it was when we trembled at mouths of caves and invented fire: Lost loves, lost opportunities, lost fortunes, lost wits, lost lives, and the strange small gain that we name wisdom and warm our hands in the ridiculous night. Much claptrap as before, and small comforts like struck matches within. Would I like to come back each hundred years to check on the forever decline and forever ressurection of that vaudeville which we call life and stage? No matter if projected on electric tube or lit by candle in a parlor? I would, by God, I *would!!* Now shut up, young man, and eat your jam and biscuit!"

And shut I do, and eat I will, and finished am I.
There's your Theatre, or Theatres for Tomorrow.
What do *you* think?□

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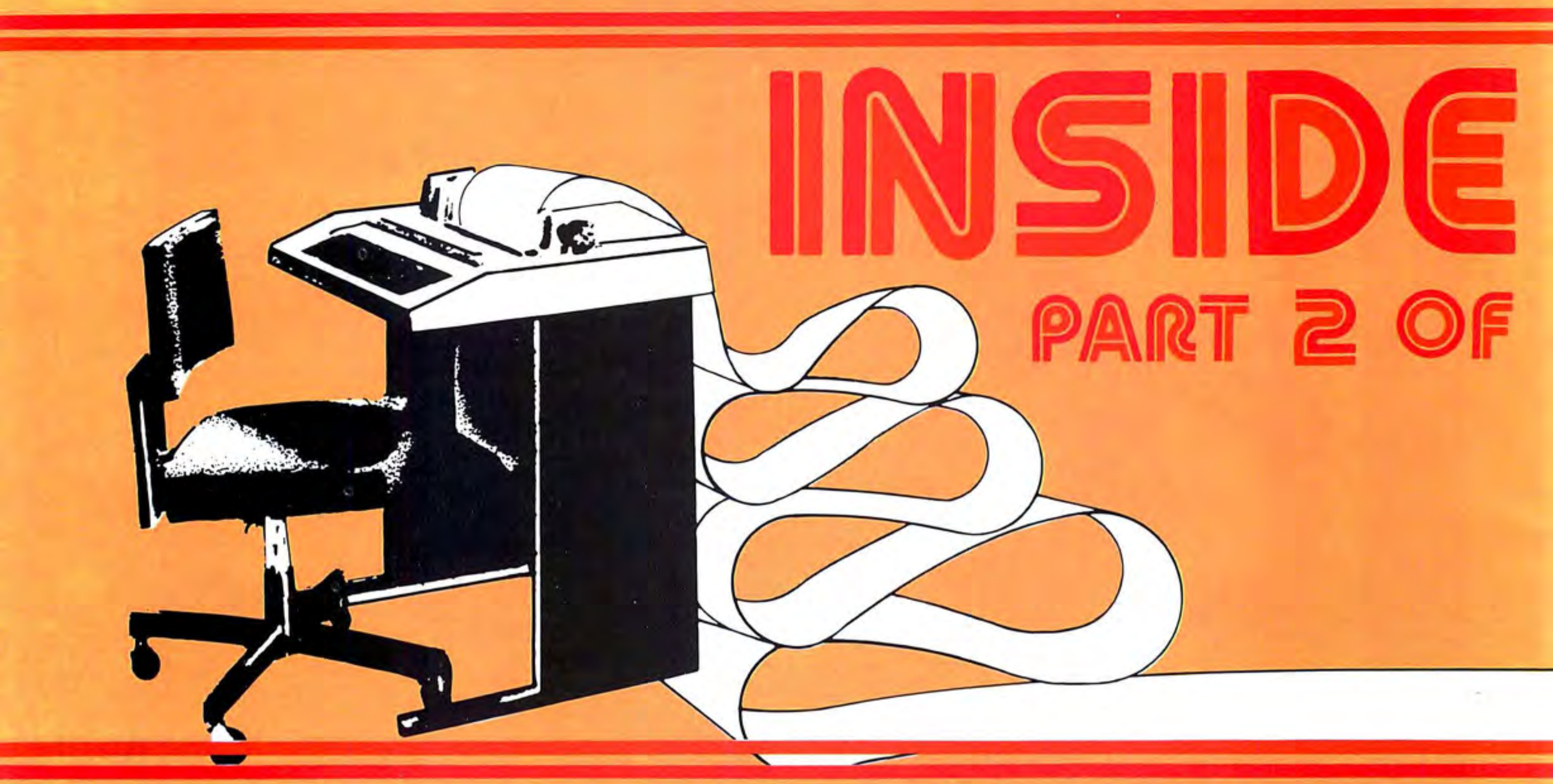


The abstract aspects of ASCII were treated in Part I. Now we come to some aspects of usage and implementation. Certainly one major use area is the ordering of files.

THE ASCII COLLATING SEQUENCE

To put items in some ordering, the entire precedence relationship for that ordering must be defined. Higher or lower, precedes or follows, or whatever. For single characters, this ordering relationship is called the "collating sequence".

The ASCII standard used to say that the collating sequence for both graphics and control characters is defined simply by their binary representations. Later it added a warning that this collating sequence "cannot be used in many specific applications that define their own sequence". What an understatement!

The 1977 version hedges and speaks all around the problem without making it clear. It's not all that difficult. Suppose you have two files, and you want to know how they differ and/or how they are the same. For this purpose, the implied collating sequence (straight binary comparison) is just fine. The two files will be in the same order, and can be matched.

Whether that straight binary ordering can be used for any other purpose is doubtful. It won't work for signed numbers.

Ordering Numerals

Take these four values: 22, 13, minus 6, and minus 31. If the sign is placed before the digits, ordering by the ASCII collating sequence yields:

+13
+22
−06
−31

This is obviously worthless. It's because ordering is decided left to right, and the minus sign has a binary value 2 higher than the plus sign. Or if the sign were to follow the numeric values we would get:

06−
13+
22+
31−

because the complete decision is made in the leading digit. Again, a worthless sequence.

The way to achieve a proper ascending sequence is to separate the values into two groups, ordering those with plus signs in ascending sequence, and those with minus signs in descending sequence. Then put the plus group following the minus group. And vice versa for a total descending sequence. Notice that this works regardless of whether the sign precedes or follows the digits.

Ordering Alphabetic Fields

Alphabetic ordering is even more complex, particularly in handling both upper and lower case. Again the implied ASCII collating sequence can go wrong. People who have not studied the collating problem for data containing both upper and lower case are inclined to jump to wrong conclusions. I did myself, for the IBM Stretch computer in 1958, assigning the ascending binary sequence as AaBbCc. Using this for a telephone directory would give us the lefthand column. The straight binary sequence of ASCII would yield the righthand column, just slightly different:

De Carlo	De Carlo
De La Rue	De La Rue
De Long	De Long
DeLair	DeLaRue
DeLancey	DeLair
DeLaRue	DeLancey
Delancey	Delancey
de Carlo	de Carlo
de la Rue	de la Rue
deLancey	deLancey

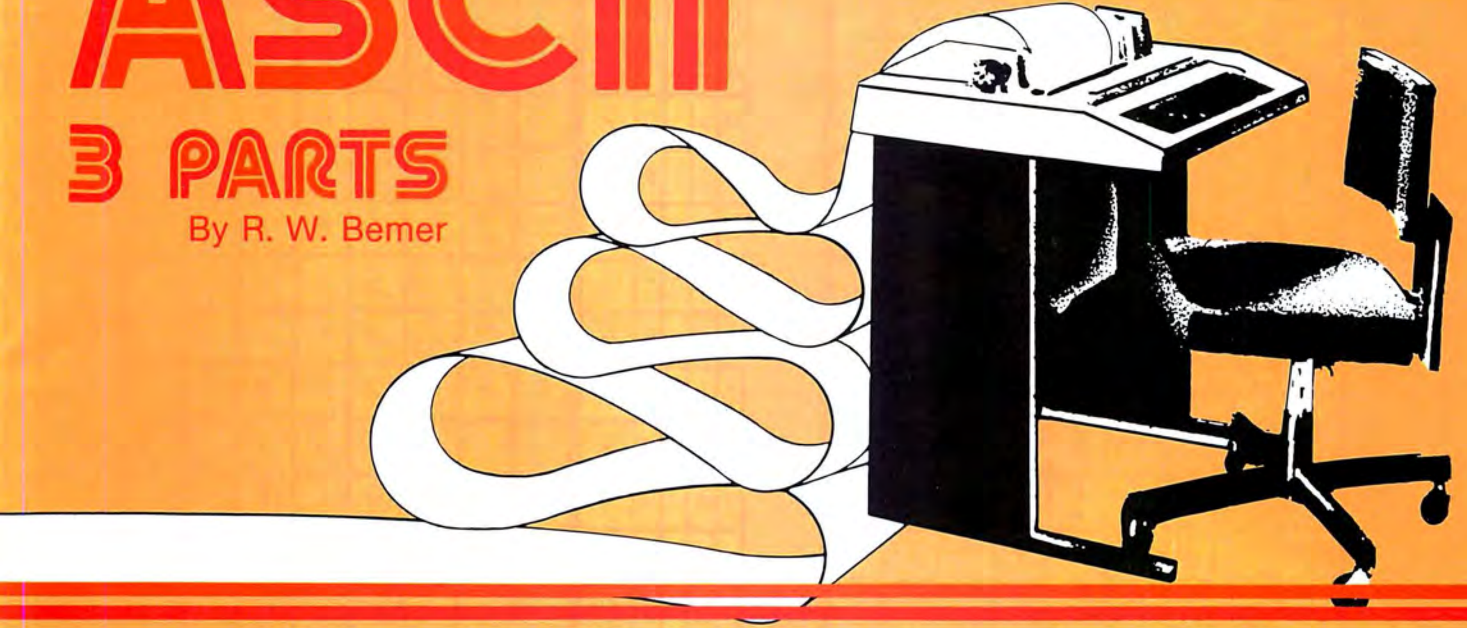
Either version will get a lot of anguished subscribers!

In the simplest case, two alphabetic items must be compared with the case ignored. Only if they are *then* equal is case called into consideration to break the tie, and it is also applied successively left-to-right!

In short, the upper and lower case versions of a letter do not both get full graphic significance. Typing either "Y" or "y" will indicate a "yes" reply, but "N" will not. Because the case distinction is minor, comparisons must first be made on major distinctions, with the minor distinctions used only as tie-breakers. Accenting of let-

ASCII 3 PARTS

By R. W. Bemer



ters must also be considered minor, if accomplished via backspace, but this leads us into rules controlled by foreign governments, and won't be considered here.

Real life is more complicated than this. The ordering and sequencing of characters and words cannot always be accomplished by simple binary comparison of codes. There are constructions such as O'Reilly, l'Informatique (as data processing is called in French), and Smith-Jones — to say nothing of the Juniors, IIIs, Esq., FBCS (which I am), and so on.

Making an ASCII comparison, with the case as a minor, gives us:

De Carlo
de Carlo
De La Rue
de la Rue
De Long
DeLair
DeLancey
Delancey
deLancey
DeLaRue

Because we at first ignored case here, De Carlo and de Carlo have identical bit patterns. Tie-breaking is done by appending the binary pattern representing case, "0" for upper, "1" for lower. Specifically, 01001111 for De Carlo, 11001111 for de Carlo.

	D	E		C	A	R	L	O	
De Carlo	44	45	20	43	41	52	4C	4F	(4F)
de Carlo	44	45	20	43	41	52	4C	4F	(CF)

But even this method will not put "DeLaRue" and "De La Rue" in the same cluster. And surely this is desirable and even mandatory. It will require some special handling for spaces. The New York Telephone Company's document on this problem runs to several pages! They'd probably give you a copy upon request. You might need to know those rules before trying one of the toughest acts in data processing — putting last name first, or vice versa.

Using Controls in Ordering

There is one more aspect of ASCII useful to the order-

				b_7	0	0	0	0	1	1	1	1
				b_6	0	0	1	1	0	0	1	1
				b_5	0	1	0	1	0	1	0	1
b_4	b_3	b_2	b_1		0	1	2	3	4	5	6	7
0	0	0	0	0			SP	0		P	←	→
0	0	0	1	1				1	A	Q	α	∨
0	0	1	0	2			"	2	B	R	⊥	ρ
0	0	1	1	3				3	C	S	∩	⌈
0	1	0	0	4				4	D	T	⌊	~
0	1	0	1	5				5	E	U	∈	↓
0	1	1	0	6			&	6	F	V	×	∪
0	1	1	1	7			'	7	G	W	∇	ω
1	0	0	0	8			(	8	H	X	Δ	⊃
1	0	0	1	9			)	9	I	Y	ι	∧
1	0	1	0	10			*	:	J	Z	∘	⊂
1	0	1	1	11			+	;	K	[	÷	≤
1	1	0	0	12			,	<	L	\	□	|
1	1	0	1	13			−	=	M	]	≠	≥
1	1	1	0	14			.	>	N	↑	⊤	¯
1	1	1	1	15			/	?	O	_	○	

Figure 1.

				b7	0	0	0	0	1	1	1	1
				b6	0	0	1	1	0	0	1	1
				b5	0	1	0	1	0	1	0	1
b4	b3	b2	b1		0	1	2	3	4	5	6	7
0	0	0	0	0			SP	0		P		
0	0	0	1	1			!	1	A	Q		
0	0	1	0	2			"	2	B	R		
0	0	1	1	3			#	3	C	S		
0	1	0	0	4			$	4	D	T		
0	1	0	1	5			%	5	E	U		
0	1	1	0	6			&	6	F	V		
0	1	1	1	7			'	7	G	W		
1	0	0	0	8			(	8	H	X		
1	0	0	1	9			)	9	I	Y		
1	0	1	0	10			*	:	J	Z		
1	0	1	1	11			+	;	K			
1	1	0	0	12			,	<	L			
1	1	0	1	13			-	=	M			
1	1	1	0	14			.	>	N	^		
1	1	1	1	15			/	?	O	_		

Figure 2.

				b7	0	0	0	0	1	1	1	1
				b6	0	0	1	1	0	0	1	1
				b5	0	1	0	1	0	1	0	1
b4	b3	b2	b1		0	1	2	3	4	5	6	7
0	0	0	0	0			SP	0		P		
0	0	0	1	1				1	A	Q		
0	0	1	0	2			"	2	B	R		
0	0	1	1	3				3	C	S		
0	1	0	0	4			$	4	D	T		
0	1	0	1	5				5	E	U		
0	1	1	0	6				6	F	V		
0	1	1	1	7				7	G	W		
1	0	0	0	8			(	8	H	X		
1	0	0	1	9			)	9	I	Y		
1	0	1	0	10			*		J	Z		
1	0	1	1	11			+	;	K			
1	1	0	0	12			,	<	L			
1	1	0	1	13			-	=	M			
1	1	1	0	14			.	>	N			
1	1	1	1	15			/		O			

Figure 3.

ing problem. In the days of punch cards, before computers, one often used several card files related by a key. A sorter (with pockets for the cards to drop into) might be used to select the cards for all redheaded females between 18 and 24 years of age. But these cards would have only the employee number and such characteristics on them. To get the name, address, and telephone number one might have to go to a second (related) deck of cards. So the first deck (the subset of interest) would be placed in the first hopper of a collator, and the deck with all names and phone numbers in the second hopper. Then a card would be fed from the first hopper, followed by successive cards from the second hopper, until a match was found on employee number. Obviously both decks had to be in the same ordering for this to work, and thus the term "collating sequence".

In effect, we were sticking the cards of the first deck upright just in front of the corresponding cards of the second. To do this with ASCII requires that we have characters that collate lower than the lowest graphic, the space (2/1). We do have them. The best to use are NUL, FS, GS, RS, and US. Put one of these after each search key, then put the two files together and order them as adjoined. Now those records having a search key with one of our five control characters appended will precede the corresponding record having an ASCII graphic following the key.

Note that the four information separators (FS, GS, RS, US) are designed to collate just behind Space, in that order. This contiguity means that they can be used as a hierarchy of spaces of different class.

Other Collating Features

ASCII was designed when there was substantial investment in files already ordered on a Topsy-class IBM sequence, where the basic punctuation was low to the alphabet, but the digits were high to it. How then to accommodate this and still provide a 4-bit subset? My morning shower provided a solution (it still does!).

The 4-bit subset is formed of the first 10 graphics of stick 3 (the digit graphics) and the last 6 of stick 2. This jog was shown shaded in the early forms of ASCII, but has all but disappeared from memory now. It enables stick 3 (with the digits and new special graphics) to be ordered high to all the others via passive logic, thus overcoming opposition to the adoption of ASCII.

ASCII AND PROGRAMMING LANGUAGES

Standard ECMA-53 (1978 Jan), "Representation of Source Programs for Program Interchange," gives the subsets and/or modifications of ASCII as they are used for these five programming languages (Footnote 1):

	NO. OF CHARACTERS USABLE	
Language	Subset of ASCII	Other
APL	57	32
Minimal BASIC	60	0
COBOL	51	0
FORTRAN	49	0
PL/I	55	2

Figures 1 through 5 are the character sets for these languages as given in ECMA-53. They show the only characters permissible for use in source programs, except for:

non-numeric literals	in COBOL
comment-entries	"
comment lines	"
character constants	in FORTRAN
comments	"

				b_7	0	0	0	0	1	1	1	1
				b_6	0	0	1	1	0	0	1	1
				b_5	0	1	0	1	0	1	0	1
b_4	b_3	b_2	b_1		0	1	2	3	4	5	6	7
0	0	0	0	0			SP	0		P		
0	0	0	1	1				1	A	Q		
0	0	1	0	2				2	B	R		
0	0	1	1	3				3	C	S		
0	1	0	0	4			$	4	D	T		
0	1	0	1	5				5	E	U		
0	1	1	0	6				6	F	V		
0	1	1	1	7			'	7	G	W		
1	0	0	0	8			(	8	H	X		
1	0	0	1	9			)	9	I	Y		
1	0	1	0	10			*	:	J	Z		
1	0	1	1	11			+		K			
1	1	0	0	12			,		L			
1	1	0	1	13			–	=	M			
1	1	1	0	14			.		N			
1	1	1	1	15			/		O			

Figure 4.

				b_7	0	0	0	0	1	1	1	1
				b_6	0	0	1	1	0	0	1	1
				b_5	0	1	0	1	0	1	0	1
b_4	b_3	b_2	b_1		0	1	2	3	4	5	6	7
0	0	0	0	0			ƀ	0		P		
0	0	0	1	1			|	1	A	Q		
0	0	1	0	2				2	B	R		
0	0	1	1	3				3	C	S		
0	1	0	0	4			$	4	D	T		
0	1	0	1	5			%	5	E	U		
0	1	1	0	6			&	6	F	V		
0	1	1	1	7			'	7	G	W		
1	0	0	0	8			(	8	H	X		
1	0	0	1	9			)	9	I	Y		
1	0	1	0	10			*	:	J	Z		
1	0	1	1	11			+	;	K			
1	1	0	0	12			,	<	L			
1	1	0	1	13			–	=	M			
1	1	1	0	14			.	>	N	¬		
1	1	1	1	15			/		O	_		

Figure 5.

character-string-constants in PL/I
comments "

For these purposes only, other ASCII characters may be used, providing there is agreement between the sender and receiver for any interchange of source programs.

The TEX language has gone farther than this general caution. There the specific characters have permanent names. For example, one could say:

linefeed = "
" (actual line feed inside the quotes)

if lf:eqs:linefeed ....

and it would be true, because "*lf" is the permanent name of Line Feed. The control characters have names that are the letters from the ASCII chart, preceded by the asterisk to show that they are read-only variables with permanent content. TEX can in fact operate upon all 256 characters of ASCII in an 8-bit byte, all 512 in a 9-bit byte.

Specific Notes on the Figures

APL -*Sticks 6 and 7 (ordinarily lower case alphabet) are replaced entirely except for the DELete position.*

-*Space is nonprinting, although the symbol shown is SP.*

-*Ampersand (2/6) is not used for writing source programs, except as the last character of a line if that line is to be continued on the next line.*

PL/I -*In position 2/1, the exclamation point is replaced by a vertical bar for OR.*

-*In position 5/14, the circumflex is replaced by the symbol shown, for NOT.*

-*If you have to use your terminal for both PL/I and some other programming language, forget that foolishness. You can get by with the exclamation point as OR, and the circumflex as NOT. The important point in source program interchange is to have the encoded representations of the characters exchanged correctly.*

(all) -*Although the character BLANK (space) is shown as the flagged lower case "b" in the FORTRAN and PL/I sets, there is no printing graphic to indicate it. For all practical purposes, it is really the Space of ASCII (2/0).*

-*Four of these five languages (not APL) have the "$" shown in 2/4. When the International Reference Version of the code is used, this becomes the universal currency symbol, which is also acceptable.*

-*Minimal BASIC uses "#", which is the International Reference Version symbol. The national symbols, such as the English pound sign, are also acceptable.*

ASCII AND MEDIA

ASCII and Punch Cards

Reading and punching equipment for punch cards, being very mechanical, is so expensive that microcomputer people are unlikely to use them. So you might ask why we bother here with the representation of ASCII on this medium? I can think of at least three reasons:

- A scientist at the U.S. National Bureau of Standards said once that if punch cards were on the way out, it was the only product he ever saw dying on an upward usage curve. Thus they are likely to be around for a long

	ISO	ECMA	ANSI	FIPS PUB	CSA	BS	AS	CCITT	JIS	GOST
Hollerith Punched Card Code	1679 2021	44	X3.26-1970 $4.25	14	Z243.14 .36	4636/3 /4	1063			
Track Assignment - 25.4 mm Perf. Tape	1113	10	X3.6-1965 $3.00	2	Z243.8	3880/3	1062		C6221	
Track Assignment - 12.7 mm Mag Tape 200 cpi NRZI 9-track	1862	5	X3.14-1973 $3.25			3968	1008			
Track Assignment - 12.7 mm Mag Tape 800 cpi NRZI 9-track	962 1863	12	X3.22-1973 $3.75	3-1		4503/1	1009		C6222	
Track Assignment - 12.7 mm Mag Tape 1600 cpi PE 9-track	3788	36	X3.39-1973 $3.75	25		4503/2				
Track Assignment - 12.7 mm Mag Tape 6250 cpi GCR 9-track	DP 5652		X3.54-1976 $5.25	50						
Labeling & File Structure - 12.7 mm MT	1001	13	X3.27-1977 (unpriced)		Z243.7	4732	1068			
Track Assignment - Magtape Cassette 3.81 mm, 32 bpmm	3275 3407	34	X3.48-1977 $5.75	51		5079/1				
Labeling & File Struct. - 3.81 Magtape Cassette	DIS 4341	41								
Track Assignment - 6.35 mm Cartridge Tape 64 bpmm PE	DIS 4057	46	X3.56-1977 $4.24							

Table 1a. Standards for ASCII on Physical Media.

	ISO	ECMA	ANSI	FIPS PUB	CSA	BS	AS	CCITT	JIS	GOST
Bit Sequencing in Serial Transmission			X3.15-1976 $3.00	16-1				V.4 X.4		
Char. Structure & Parity Sense - Serial-by-Bit			X3.16-1976 $3.50	17-1				V.4 X.4		
Char. Structure & Parity Sense - Parallel-by-Bit			X3.25-1976 $3.50	18-1				V.4 X.4		
Procedures for Using Commun. Control Chars.	1745	16	X3.28-1976 $10.50		Z243.13	4505/1	1484/1			
Message Heading Formats	1745		X3.57-1977 $5.25							
Advanced Data Commun. Control Procedures			BSR X3.66							

Table 1b. Standards for ASCII in Communications.

				b8	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
				b7	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
				b6	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
				b5	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
b4	b3	b2	b1		00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
0	0	0	0	00	12-0-9-8-1	12-11-9-8-1		0	8-4	11-7	8-1	12-11-7	11-0-9-8-1	12-11-0-9-8-1	12-0-9-1	12-11-9-8	12-11-0-9-6	12-11-8-7	12-11-0-8	12-11-9-8-4
0	0	0	1	01	12-9-1	11-9-1	12-8-7	1	12-1	11-8	12-0-1	12-11-8	0-9-1	9-1	12-0-9-2	11-8-1	12-11-0-9-7	11-0-8-1	12-11-0-9	12-11-9-8-5
0	0	1	0	02	12-9-2	11-9-2	8-7	2	12-2	11-9	12-0-2	12-11-9	0-9-2	11-9-8-2	12-0-9-3	11-0-9-2	12-11-0-9-8	11-0-8-2	12-11-0-8-2	12-11-9-8-6
0	0	1	1	03	12-9-3	11-9-3	8-3	3	12-3	0-2	12-0-3	11-0-2	0-9-3	9-3	12-0-9-4	11-0-9-3	12-0-8-1	11-0-8-3	12-11-0-8-3	12-11-9-8-7
0	1	0	0	04	9-7	9-8-4	11-8-3	4	12-4	0-3	12-0-4	11-0-3	0-9-4	9-4	12-0-9-5	11-0-9-4	12-0-8-2	11-0-8-4	12-11-0-8-4	11-0-9-8-2
0	1	0	1	05	0-9-8-5	9-8-5	0-8-4	5	12-5	0-4	12-0-5	11-0-4	11-9-5	9-5	12-0-9-6	11-0-9-5	12-0-8-3	11-0-8-5	12-11-0-8-5	11-0-9-8-3
0	1	1	0	06	0-9-8-6	9-2	12	6	12-6	0-5	12-0-6	11-0-5	12-9-6	9-6	12-0-9-7	11-0-9-6	12-0-8-4	11-0-8-6	12-11-0-8-6	11-0-9-8-4
0	1	1	1	07	0-9-8-7	0-9-6	8-5	7	12-7	0-8	12-0-7	11-0-6	11-9-7	12-9-8	12-0-9-8	11-0-9-7	12-0-8-5	11-0-8-7	12-11-0-8-7	11-0-9-8-5
1	0	0	0	08	11-9-6	11-9-8	12-8-5	8	12-8	0-7	12-0-8	11-0-7	0-9-8	9-8	12-8-1	11-0-9-8	12-0-8-6	12-11-0-8-1	12-0-9-8-2	11-0-9-8-6
1	0	0	1	09	12-9-5	11-9-8-1	11-8-5	9	12-9	0-8	12-0-9	11-0-8	0-9-8-1	9-8-1	12-11-9-1	0-8-1	12-0-8-7	12-11-0-1	12-0-9-8-3	11-0-9-8-7
1	0	1	0	10	0-9-5	9-8-7	11-8-4	8-2	11-1	0-9	12-11-1	11-0-9	0-9-8-2	9-8-2	12-11-9-2	12-11-0	12-11-8-1	12-11-0-2	12-0-9-8-4	12-11-0-9-8-2
1	0	1	1	11	12-9-8-3	0-9-7	12-8-6	11-8-6	11-2	12-8-2	12-11-2	12-0	0-9-8-3	9-8-3	12-11-9-3	12-11-0-9-1	12-11-8-2	12-11-0-3	12-0-9-8-5	12-11-0-9-8-3
1	1	0	0	12	12-9-8-4	11-9-8-4	0-8-3	12-8-4	11-3	0-8-2	12-11-3	12-11	0-9-8-4	12-9-4	12-11-9-4	12-11-0-9-2	12-11-8-3	12-11-0-4	12-0-9-8-6	12-11-0-9-8-4
1	1	0	1	13	12-9-8-5	11-9-8-5	11	8-6	11-4	11-8-2	12-11-4	11-0	12-9-8-1	11-9-4	12-11-9-5	12-11-0-9-3	12-11-8-4	12-11-0-5	12-0-9-8-7	12-11-0-9-8-5
1	1	1	0	14	12-9-8-6	11-9-8-6	12-8-3	0-8-6	11-5	11-8-7	12-11-5	11-0-1	12-9-8-2	9-8-6	12-11-9-6	12-11-0-9-4	12-11-8-5	12-11-0-6	12-11-9-8-2	12-11-0-9-8-6
1	1	1	1	15	12-9-8-7	11-9-8-7	0-1	0-8-7	11-6	0-8-5	12-11-6	12-9-7	11-9-8-3	11-0-9-1	12-11-9-7	12-11-0-9-5	12-11-8-6	12-11-0-7	12-11-9-8-3	12-11-0-9-8-7

Figure 6.

	12	11	0		12-0	12-11	11-0	12-11-0
	02/06	02/13	03/00	02/00	07/11	07/12	07/13	11/10
1	04/01	04/10	02/15	03/01	06/01	06/10	07/14	13/09
2	04/02	04/11	05/03	03/02	06/02	06/11	07/03	13/10
3	04/03	04/12	05/04	03/03	06/03	06/12	07/04	13/11
4	04/04	04/13	05/05	03/04	06/04	06/13	07/05	13/12
5	04/05	04/14	05/06	03/05	06/05	06/14	07/06	13/13
6	04/06	04/15	05/07	03/06	06/06	06/15	07/07	13/14
7	04/07	05/00	05/08	03/07	06/07	07/00	07/08	13/15
8	04/08	05/01	05/09	03/08	06/08	07/01	07/09	14/00
9	04/09	05/02	05/10	03/09	06/09	07/02	07/10	14/01
8-2	05/11	05/13	05/12	03/10	12/04	12/11	13/02	14/02
8-3	02/14	02/04	02/12	02/03	12/05	12/12	13/03	14/03
8-4	03/12	02/10	02/05	04/00	12/06	12/13	13/04	14/04
8-5	02/08	02/09	05/15	02/07	12/07	12/14	13/05	14/05
8-6	02/11	03/11	03/14	03/13	12/08	12/15	13/06	14/06
8-7	02/01	05/14	03/15	02/02	12/09	13/00	13/07	14/07

12	11	0		12-0	12-11	11-0	12-11-0	
10/08	11/01	11/09	06/00	12/03	12/10	13/01	13/08	8-1
00/01	01/01	08/01	09/01	10/00	10/09	09/15	11/11	9-1
00/02	01/02	08/02	01/06	10/01	10/10	11/02	11/12	9-2
00/03	01/03	08/03	09/03	10/02	10/11	11/03	11/13	9-3
09/12	09/13	08/04	09/04	10/03	10/12	11/04	11/14	9-4
00/09	08/05	00/10	09/05	10/04	10/13	11/05	11/15	9-5
08/06	00/08	01/07	09/06	10/05	10/14	11/06	12/00	9-6
07/15	08/07	01/11	00/04	10/06	10/15	11/07	12/01	9-7
09/07	01/08	08/08	09/08	10/07	11/00	11/08	12/02	9-8
08/13	01/09	08/09	09/09	00/00	01/00	08/00	09/00	9-8-1
08/14	09/02	08/10	09/10	14/08	14/14	15/04	15/10	9-8-2
00/11	08/15	08/11	09/11	14/09	14/15	15/05	15/11	9-8-3
00/12	01/12	08/12	01/04	14/10	15/00	15/06	15/12	9-8-4
00/13	01/13	00/05	01/05	14/11	15/01	15/07	15/13	9-8-5
00/14	01/14	00/06	09/14	14/12	15/02	15/08	15/14	9-8-6
00/15	01/15	00/07	01/10	14/13	15/03	15/09	15/15	9-8-7

Figure 7.

time, and you may need to transfer some of those files to other media that you do use.

- There is some likelihood that microcomputers could be used in the reading and punching equipment itself, to make it less expensive.
- ASCII users are going to be confronted for a while yet with one of the several versions of IBM's EBCDIC, and the punch card assignments provide the only legitimate link for conversion of EBCDIC files to ASCII.

So Figure 6 defines the hole patterns for the binary encodings. And Figure 7 defines the encodings for the hole patterns. Don't worry about the inconsistency in the relationships. Nothing can be done about it now, because it started with Herman Hollerith's first U.S. Census machines in 1890. At first only digits and + and – signs were used. Then the code was expanded to the upper case alphabet. And other special characters for commercial use. When FORTRAN came along in 1964, it turned out that the limited capability of the subset of a 6-bit set would not permit the graphics needed for scientific work. For a long while there were dual graphic representations for several of the punch card code combinations, and this carried over into printer chains, and so on.

The only logic that the patterns follow is that they do or do not have a punch from among these six possibilities:

- 12-punch (top row)
- 11-punch (next to the top row)
- 0-punch
- 8-punch
- 9-punch (bottom row)
- a punch from among the digits 1 through 7

Including the no-punch-at-all combination (NUL), this gives 256 combinations, just right for the 8-bit code. Although ASCII was technically only a 7-bit code at the time this rule was formulated, it was felt necessary to plan ahead a little.

ASCII and Magnetic Tape

Figure 8 gives a compact representation of several relationships, among which is the assignment of ASCII bit pattern to 9-track magnetic tape. The jumbled assignment may remind you of the "firing order" for the cylinders of an automobile engine. In fact, we used to call it just that. It was intentional for increased reliability. As in so many cases, better technology has removed the need for peculiar design, but the assignments are unchangeable because of data file investment.

There is no parallelism in recording and reading on cassettes and cartridges. The ASCII bits are recorded serially in the track. Thus Figure 8 does not consider these media.

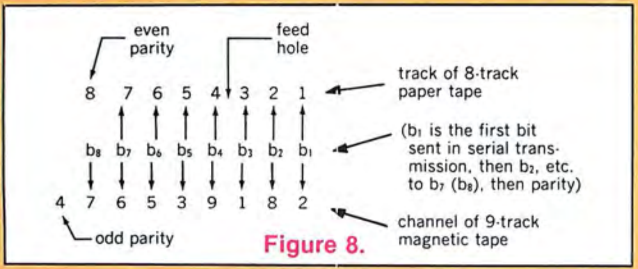


Figure 8.

ASCII and Communications

Not only is the topic of ASCII and communications a very complex and large dissertation for this article — it is also undergoing substantial rethinking, enlargement, and invention. You will have to follow on your own the workings of the CCITT, the various networking systems of the several large and many small manufacturers of computer systems, and the offerings of the common carriers — either on the local distribution system (via ATT) or direct distribution (via Satellite Business Systems).

Many of the existing standards are listed in Table 1b. Many more are under development. Arguments are raging internationally on the merits of packet switching, byte protocols, value-added systems, open-working systems, tariffs, data movement across national borders, the X.25 protocol, etc., etc. ATT is offering a new service because they suddenly discovered data-undervoice (DUV). All I can tell you now is that it is all based upon ASCII, and the proposed protocols are all dependent upon the ASCII control characters in stick 0 and 1. It will take years for this to shake out, and for now all one can do is get on the CBEMA mailing list (see reference, Part I, INTERFACE AGE, May, 1978).

ASCII AND THE METRIC SYSTEM

The full ASCII graphic set (both cases) is sufficient to indicate all symbols and prefixes of the SI (International System of Units, the new metric system), with three exceptions. They are the Greek letters "omega" for "ohm", and "mu" for "micro", and the degree symbol for Celsius temperature. These three characters will be provided in 8-bit ASCII (see Part III, next month). Meanwhile, for these, and also for such equipment that has only a single case, there is a standard way of representing the SI units and prefixes. This is given in International Standard 2955, "Representations of SI Units and Other Units for Use in Systems with Limited Character Sets", and also in American Standard X3.50-1976.

To keep the record straight, let's first look at the characters used for the prefixes. They're shown in Table 2, which indicates multiples from 10 to the – 18 up to 10 to the + 18:

10 + i	i	10 – i
exa (E)	18	atto (a)
peta (P)	15	femto (f)
tera (T)	12	pico (p)
giga (G)	9	nano (n)
mega (M)	6	micro (μ)
kilo (k)	3	milli (m)
hecto (h)	2	centi (c)
deka (da)	1	deci (d)

Table 2. Metric Prefixes

Above 3 there are no powers except multiples of 3. This practice breeds better comprehension, like marking off three's in writing numbers of many digits. Also, as a memory convenience, all symbols are upper case for powers greater than + 3. And there are no conflicts with the symbols for the units of measurement.

Now, again for the record, here are the ASCII character(s) used as symbols for the units:

A	ampere	cd	candela
Bq	becquerel	d	day
C	coulomb	g	gram
°C	degree celsius	h	hour
F	farad	l	litre
Gy	gray	lm	lumen
H	henry	lx	lux
J	joule	μ	micro
K	kelvin	m	metre
N	newton	min	minute (time)
Ω	ohm	mol	mole
Pa	pascal	rad	radian
S	siemens	s	second (time)
T	tesla	sr	steradian
V	volt	t	tonne/metric ton/ megagram
W	watt		
Wb	weber		

Table 3. Metric Units

Table 3 shows the rules clearly. Units not named after people are all lower case, as shown in the righthand column (although I do know a Mr. Day). In the lefthand col-

umn are the units that are named after people. The names of the units are not capitalized at all, but the symbols begin with an upper case letter.

I said previously that there were no conflicts between unit and prefix symbols. But you've probably noticed "d" for both "day" and "deci", "h" for both "hour" and "hecto", "m" for both "metre" and "milli", and "T" for both "tesla" and "tera". OK. But there isn't any confusion in actual usage, because the prefix precedes the unit:

dd	is a deciday (2.4 hours)
hh	is a hectohour (100 hours)
hH	is a hectohenry (but don't ever use the term)
mm	is a millimetre
Mm	is a megametre (1/300 the speed of light)
TT	is a teratesla (Wow!)

I am not suggesting that the prefixes should be applied to other than the primary metric units (the second is the primary time unit; hour and day are not), even though the timesharing system I customarily use figures my time in millihours. But when you get accustomed, the prefixes are very valuable in other ways. For example, an American billion is a kilomillion, whereas the British billion is a megamillion! And my metric teaching program understands such things as kilofathoms.

The "space" character is also vital to correct SI usage. It must occur between values and units, like 123.6 mm, and 22 °C.

And don't forget another peculiarity of ASCII as an international alphabet: (1/14) is absolutely not defined as a "decimal point" (nor is it defined as "period", which in the United Kingdom is "full stop"). For most of the rest of the world, the comma (1/12) is the decimal marker, and the period is used to mark off threes. That's why the recommended practice for marking off threes is to use the space, not either comma or period. E.g., "1 234 567 mm".

To save you the bother of looking up the standards for use with limited character sets, here is the algorithm:

1. If you have ASCII with both cases of alphabet, the three missing symbols are handled as:

ohm	for Ω
Cel (initial cap)	for °C
u (lower case)	for μ (micro)

2. If you have only one case of alphabet (either upper or lower), use it, and these three replacements remain as:

OHM		ohm
CEL	or	cel
U		u

And in addition:

S (siemens)		SIE		sie
h (hour)	become	HR	or	hr
t (tonne)		TNE		tne

Examples:

16 UOHM is 16 $\mu\Omega$

373.15 K = 100 Cel

Notice that no plurals are used in symbol combinations — MICROOHMS, but UOHM.

ASCII AND KEYBOARDS

Technically, a keyboard is an ASCII keyboard if it generates the proper codes for the full set of ASCII graphic and control characters. Moreover, none of the graphic characters should have any control properties.

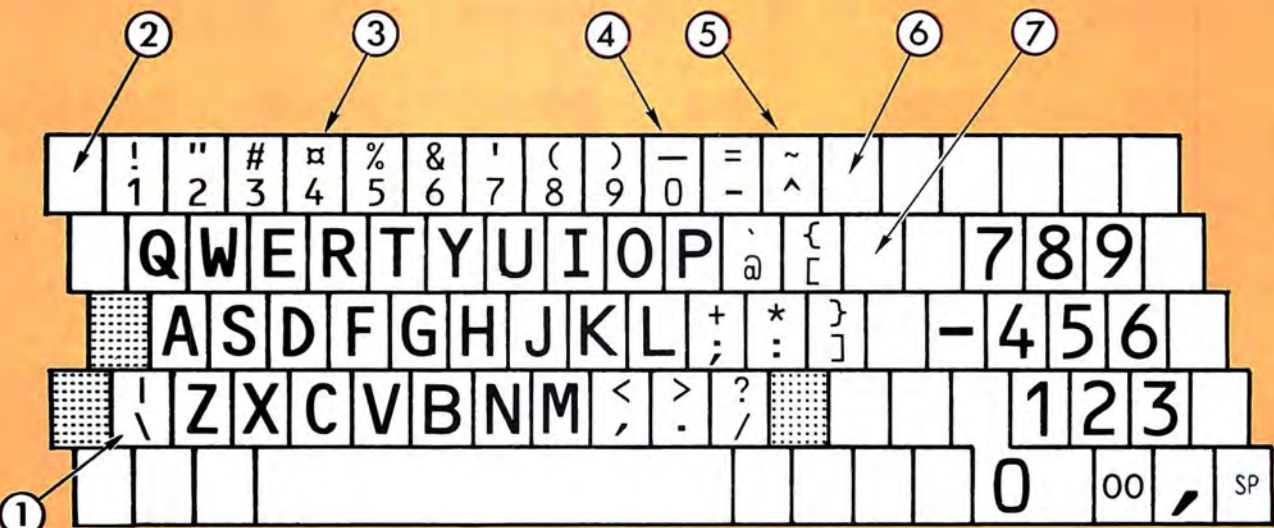
There are many types of special keyboards — Dvorak, a two-sided one used like an accordion with the hands in a vertical plane, Touch-Tone and its derivatives, etc. There are no formal standards to relate these keyboards to ASCII. For typewriter-style keyboards, however, there are two versions given in the American National Standard. One is derived from the usual electric typewriter keyboard, the other is called the "bit-paired" keyboard. Only the bit-paired keyboard will be shown and discussed here, because the other form is the subject of proposals for extensive change due to the growth of Word Processing. ANSI Committee X4A12 is studying this now.

The bit-paired keyboard was designed for minimum circuitry cost. Thus the "at" symbol (4/0) is paired with the accent grave (6/0), "A" (4/1) with "a" (6/1), and "+" (2/11) with ";" (3/11). Thus the shift key affects each other key by only a 1-bit change.

This keyboard is shown in Figure 9. It is the interchange keyboard of ECMA-33. The numbered arrows key to the notes on changes that would make this ECMA keyboard into the ANSI keyboard for ASCII. It is also equivalent to the keyboard of ISO Standard 2530-1975 (Footnote 2).

Notes for Figure 9

1. *For and ANSI keyboard, this key is put to the right of the circumflex key, on the top row (see Note 6). The Shift Key is put in its place.*
2. *If this key exists and is available, the ECMA and ISO standards put the underscore here, removing it from the "zero" key.*
3. *The ANSI keyboard of course puts a "$" here in place of the international currency symbol.*
4. *This is where the underscore is removed for the 48-key keyboard (see Note 2).*




8
0 1 2 3 4 5
6 7 8 9 A B
C D E F G H
I J K L M N
O P Q R S T
U V W X Y Z

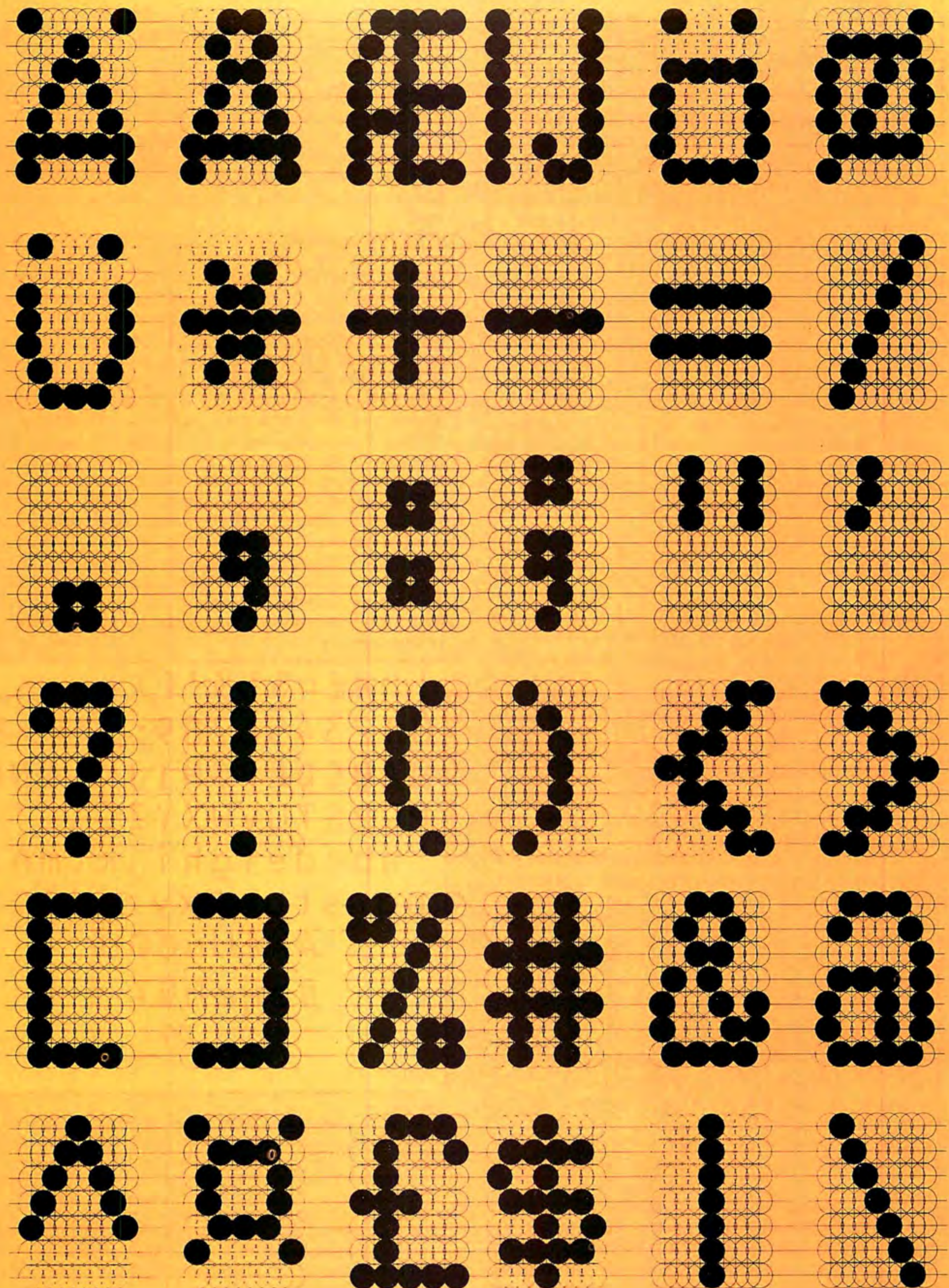


Figure 10.

5. *Here ECMA and ISO show the "overline" instead of the "tilde." It's a question of styling.*
6. *The ANSI keyboard has the reverse slash and vertical bar here, rather than between the shift key and "Z" (see Note 1).*
7. *The ANSI keyboard specifies the underscore here, in both shifts, rather than the positions shown as options in Notes 2 and 4. Practically no keyboards follow this. In fact, as I am entering this text, this is the* ***only*** *key where my Infoton Vistar deviates from the ANSI standard. It has Line Feed there, with Return to its right — a very sensible arrangement.*

Customarily, the Control Key is also tied to bit-pairing in such keyboards. The standards recommend that characters created in combination with the Control Key should use the graphic key in sticks 4 or 6 units higher. Thus "X" (5/8) or "x" (7/8) in combination with the Control Key produce CAN (1/8). Unfortunately this also means that Control-C generates ETX (0/3). And whereas Control-X as CAN is used frequently, to erase an input line of text, ETX is not often wanted. Yet it is a common miskeying to hit C rather than X. In many timesharing systems you will get a disconnect rather than a line delete.

Control and Function Keys

The so-called "QWERTY" arrangement is prevalent throughout the world. Even the French "AZERTY" set is being considered for change. But on top of these basics there are hundreds of keyboard varieties. Some of them have "dead keys" (i.e., the platen or printing element is not advanced when they are hit). This avoids having to use BS for accented letters, but it also creates difficulties in code generation.

There are some general good practices that ASCII keyboards should follow. To facilitate usage by those experienced with typewriters, all controls not used with typewriters should be located outside the customary touch-typing area. As a specific example, the Break/Interrupt key should be located where it is a definite effort to reach it (not mixed in with the keyboard). ISO 3244 may be consulted for these considerations.

Function Keys are those that generate sequences of more than one ASCII character. Examples are cursor keys, Erase-to-EOL, etc. They should be located in special clusters. Most importantly, they must all generate ASCII codes for transmission when in character-at-a-time mode. I know of video terminals where the cursors do not generate codes, as they should not while in full page buffered mode; but they still operate in line mode without generating codes. In this case the screen is alterable, but there is no way of detecting it in the computer.

Many keyboards will have some function keys that are unlabeled, for do-it-yourself assignment. These should also be clustered separately, and generate code sequences when in line mode.

ASCII AND DISPLAY PRINTING

When ASCII characters are displayed, it may be on a video screen, paper, or COM (microfiche).

On the video screen there are a number of methods to form the characters, mostly at the manufacturer's preference. They are usually at pica (constant-width) spacing for economy, so an approximation of graphic quality (such as typesetting) is not obtainable. When lower case is available, the risers and tails extend above and below the line for some screens. In others, they fall within the boundary lines of the upper case characters. They may be shown in inverse video (light background block), or highlighted by different brightness or blinking. Controls for this work will be taken up in Part III of this article.

For paper copy one usually finds either direct impact of a formed letter, or stylus printing. Either method is suitable to proportional spacing if desired. Recently there has been a general trend toward using the 7x9 dot matrix shapes of ECMA Standard 42 for stylus printers. This set of graphics is shown in Figure 10.

For hard print elements, of course, one can get a nearly infinite variety of styles and fonts. There are only two, however, specifically associated with computers — OCR-A and OCR-B. "OCR" stands for "Optical Character Recognition", meaning that the shapes are so styled that a computer-controlled scanner can read the characters as printed on paper, and encode them directly from their shapes.

OCR-A is not suitable for human reading. It's the funny looking one with the diamond-shaped letter "Oh." I won't dignify it by showing the font here. It was thought formerly, with technology of that day, that making humans work harder to read letters would make it easier and thus cheaper for computers to read them. This argument turned out to be specious, and with today's technology there is no need to use anything other than OCR-B.

OCR-B is specified in ISO 1073/2, ECMA-30, and ANSI X3.49. It is the font shown in Figure 11. I have it on my IBM golfball typewriter at home, and on my daisywheel element at the office. So it should be available for most hard elements, including the carousel type.

The first six rows correspond to ASCII sticks 2-7. In the first row, the pound and universal currency symbol are for replacement as needed. In the fourth row, the underline is discontinuous; a continuous form is shown in the auxiliary set. This set also contains a matching accent acute instead of single quote, the real circumflex (not an up arrowhead), a cedilla, and an "m" of better proportion. □

```
 ! " # £ ¤ $ % & ' ( ) * + , - . /
0 1 2 3 4 5 6 7 8 9 : ; < = > ?
@ A B C D E F G H I J K L M N O
P Q R S T U V W X Y Z [ \ ] ^ _
` a b c d e f g h i j k l m n o
p q r s t u v w x y z { | } ~
        Ä Å Æ IJ Ñ Ö Ø Ü
        å æ ij ø ß § ¥
        ¨ ´ ^ ¸ m _
```

Figure 11.

Footnotes

1. With the distribution, ECMA said "ECMA-53 is an attempt to improve portability of programs. It links the language character sets defined by the language standards, their coded representatives by means of the 7-bit code and the implementations on data carriers (punched tape, punched cards, magnetic tape and magnetic tape cassettes and cartridges). It is a standard of a new type in which already standardized features are assembled in a new standardized combination aimed at supporting interchange and decreasing implementation dependency."
2. ISO 2530 is for the alphanumeric area of the keyboard only. It is augmented by ISO 3243-1975 — Keyboards for Countries whose Languages have Alphabetic Extenders, Guidelines for Harmonizations, and also by ISO 3244-1974 — Principles Governing the Positioning of Control Keys on Keyboards.
   The fact that these are "guidelines" and "principles" indicate the complexity of the subject. Typewriter manufacturers now supply over a hundred different keyboard arrangements, as their catalog will indicate.

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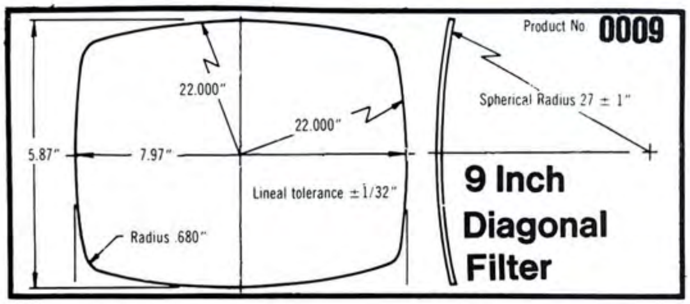

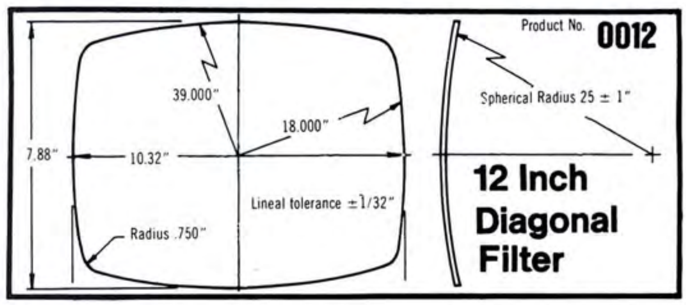

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THE EVOLUTION OF A

MODULAR BUSINESS COMPUTER

By Donald A. Burns and Milton C. Hubatka
Space Byte Corporation

BACKGROUND

When Space Byte entered the microcomputer industry, the market was virtually undefined. The hobbyist was still the primary buyer of micro's. However, there was a great deal of excitement being generated over the possibilities of using the microcomputer in business environments.

Although the hardware technology existed, there was a missing link. The missing link was of course application software. Without totally user defined application software, the micro was destined to be nothing more than a magnificent toy.

After analyzing the situation and determining what was available, we were able to make the decisions necessary to direct the course of our system design.

We were also adamant about providing application software to make the machine perform for a small business . . .

DEVELOPING THE SYSTEM

Space Byte was able to capitalize on an outburst of technology by the leading semiconductor manufacturers — namely the 4K static RAM, which allowed us to produce the first 16K fully static memory on the market. . . the 16K Space Byte. Shortly thereafter, we introduced the Space Byte 8085 CPU, a single card S-100 computer. This card is capable of supporting all of the peripherals necessary for a disk based business computer which includes, CRT, printer and iCOM flexible disk drive system.

Packaging and software seemed to be our next hurdle. We wanted to depart from the normal table top assortment of black boxes, terminals, and printers. We were also adamant about providing application software to make the machine perform for a small business, specifically the first time user.

The solutions seemed obvious. The software group began writing application modules in BASIC. Simultaneously, we prototyped a floorstanding mainframe which resembled a mini, measuring 30 x 30 x 18. This mainframe was capable of housing up to four 8" disk drives and several separate card cages, to support multi-user applications. It was dubbed the "Space Mate." We brought it to the personal computing expo in Chicago, last October, and the response was somewhat encouraging; however, it wasn't a winner in our minds.

Although our solution to the mainframe was a departure from the competitive norm, it was diametrically opposed to our product design philosophies of high density packaging. There had to be a better answer, but it wasn't at our fingertips. The application software written in BASIC ran very slow, (even with the 50% increase in speed of the 8085 processor.) It consumed too much memory and it was very difficult to make all of the modules interact. Both projects were abandoned.

THE SECOND TIME AROUND

We regrouped. There was only one alternative to the application software and that was to start from scratch, this time using assembly language. It was indeed an ambitious undertaking, but the rewards endless. Concurrently, John Munsey, chief of engineering, looked down at the stand his Hazeltine 1500 was sitting on and screamed, "My God, I've been sitting on it for a year." John had come up with the answer to the packaging problem: A terminal mounted mainframe which is a high density natural, and could only be achieved with a single card computer. The aesthetics of the Hazeltine 1500 always excited us, and the modular terminal mounted mainframe would enhance both its appeal and entire system serviceability. Additionally, the mainframe ventilates the Hazeltine to provide it with forced air cooling. Mounting the iCOM disk vertically on the base of the machine stand was a natural, keeping it integrated with the computer, short of building it into a desk — that in itself is a tremendous cost advantage.

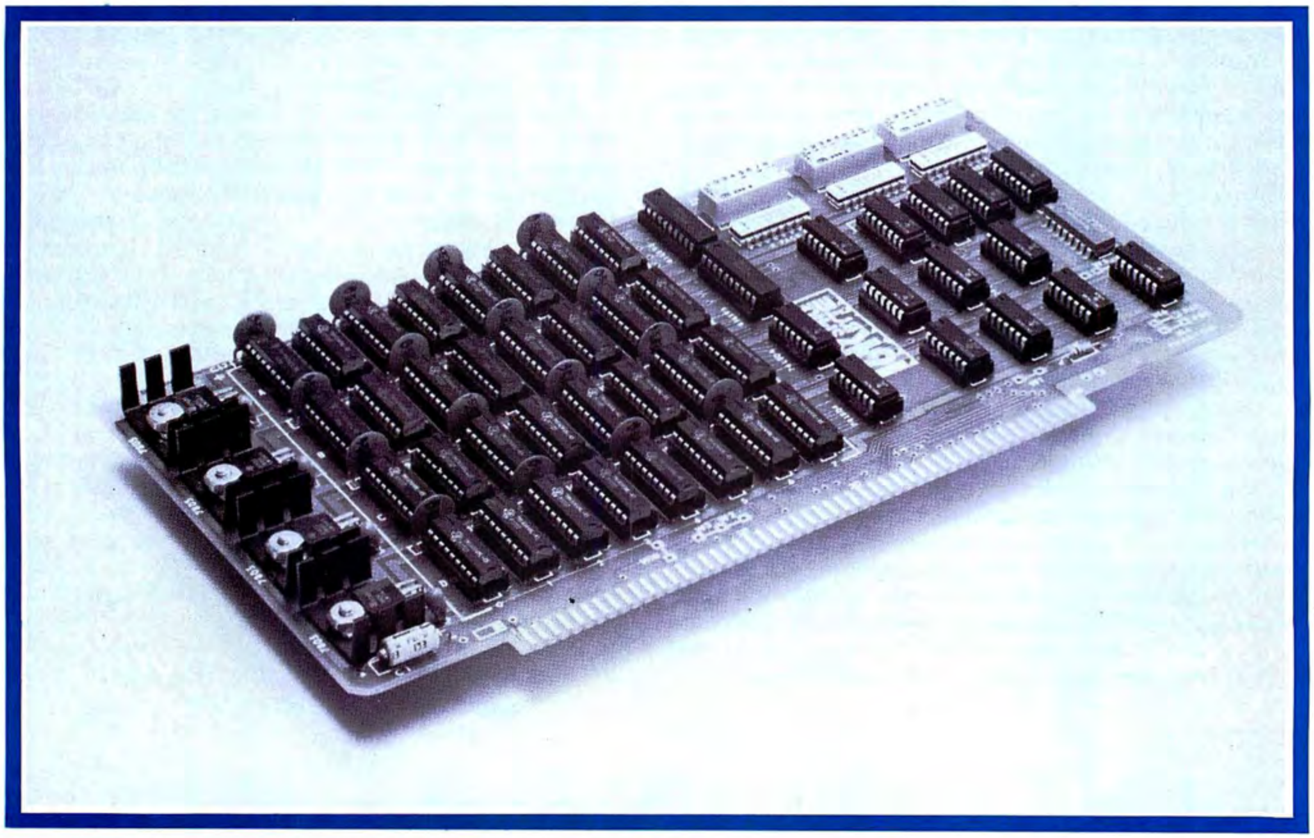
We prototyped two machines and previewed them at Micro Business '78, Pasadena, California, sponsored by INTERFACE AGE. The response was staggering, for not only was it the only modular business computer at the show, complete with application software, it was priced at less than half of anything comparable.

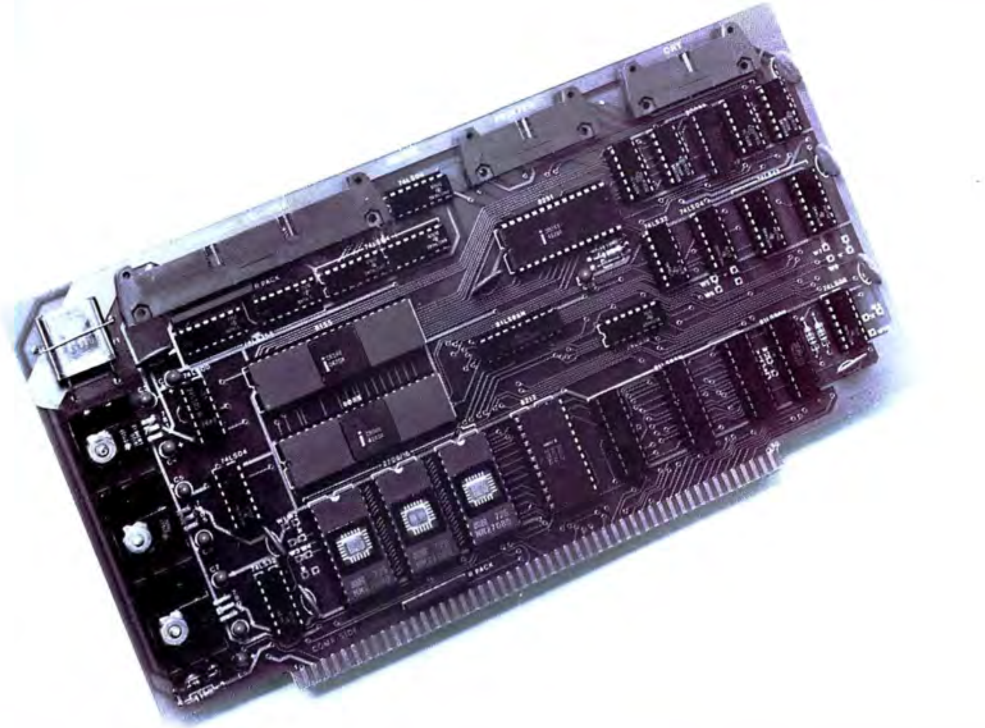
ESTABLISHING THE SOFTWARE

Although the machine is very aesthetically pleasing, the key is the assembly language "BIZPAK." It's short for Business Interactive Disk Based Application Software Package, and it is supplied free of charge with the purchase of a system. We do, however, charge a $10 per month — mandatory first year — software maintenance contract, renewable yearly. In accordance with the contract, Space Byte will provide at least two updates per year, whether it be a bug fix or the release of a new module. Updates beyond the two are provided for a modest copying and shipping charge.

When a business end user makes the decision to purchase a computer system, he has two choices available regarding software. One, he can buy hardware and hire a programmer to write the application package to his specifications, assuming that he is capable of recognizing them. Or two, he can accept a "canned" package from the manufacturer, and adapt his bookkeeping practices to the computer. The latter is the approach we chose to offer. We felt this provided a concrete basis for the end user to acclimate himself and employees to the use of office automation. As with any new bookkeeping system, there is a certain amount of compromising to be done by the user. However, it is very likely that his current bookkeeping practices will readily adapt to the BIZPAK. We recommend that users give themselves at least six months to become familiar with the system, before augmenting with additional software modules. In the event that the user needs some special software written to supplement that of the BIZPAK, source listings of the file structure are provided, to allow a programmer to interface additional modules. These additional modules may be written in either assembly language or BASIC.


SPACE
BYTE





When we were devising the architecture of the BIZPAK, optimizing the disk system was of special importance. Therefore we made special note of how each of the four modules: accounts payable, receivable, payroll and general ledger — should interact with each other, and how the files needed to be structured to accommodate this. Using assembly language, it would be easy to write a very concise, disk intensive package, that talked directly to the FDOS intrinsic to the Space Byte 8085 CPU system monitor. This would virtually protect the software, in that the BIZPAK won't run on any machine but the Space Byte CPU. Additionally, we knew that the software package had to be entirely user proof. That is, it should be self prompting, to allow a complete novice to comfortably operate the system. File maintenance would have to be transparent to the user, and error messages in plain English. Most importantly, if the user does make an error, such as having the wrong data diskette in the drive, the computer should tell him so, and not jump back to the system monitor, destroying the data he has just entered.

Another very important factor is realizing the limitations of the microcomputer and its storage capacity. Certainly multi-megabyte disks are available; however, a low cost machine must make use of what is available within the price range. It is for this reason that we elected to write a report generating system. Within this system only open invoices or active accounts are kept on diskette. Once an invoice is paid, an appropriate report is generated, and that file is automatically written over.

With all of these design criteria in mind, the software group, under the direction of John Munsey, began cranking out code. First, the data base entry and editing portion of the BIZPAK were written, allowing for the user to enter all of his vendors, customers and invoices etc. Once the data base is intact, report generation can be done.

The BIZPAK program diskette, which resides on Drive 0, contains each of the program modules and help files with each of the program's menus. Each module then utilizes a data diskette in Drive 1. Accounts payable, receivable and payroll each have a scratch file on the program diskette to update the general ledger. Each data diskette for both accounts payable and receivable will hold 500 vendors or customers and 2000 open invoices. Each module is interactive with the general ledger.

JUST BEGINNING

The Space Byte modular business computer is being marketed through systems houses and a select group of computer retailers capable of providing the customer with product support such as "handholding," through data base entry and hardware maintenance. The hardware maintenance is supplemented by Space Byte's overnight exchange policy on system components. Space Byte also generates the third party hardware maintenance contract between the retailer and end user.

With the addition of the Space Byte 2708/2716 EPROM programmer, the modular business computer becomes the modular development system, which we feel is one of the most cost effective alternatives in the market place. We offer two separate operating systems, both iCOM FDOS III and CP/M. Each have many different alternatives for a high level language, such as FORTRAN-80, disk extended BASIC, and the soon to be released Microsoft COBOL.

The trend in small business is leading towards office automation, because it is the most cost effective alternative to accommodate expansion. Even though many of the nation's leading economists project a slower U.S. economic growth rate in the next year, many believe that the computer industry will not be affected adversely. Consequently, the past year has been very eventful at Space Byte, and developing a product line to keep abreast of this fast growing industry has been a satisfying experience for our entire group. □

Considerations for Computer Implementation in A Small Business

Part II of 4 Parts

By Roger Williams

Illustrated by John Laven

PART 2 — ECONOMIC ANALYSIS OF A HYPOTHETICAL SMALL BUSINESS

This is the second part of a four-part series discussing computer implementation in the small business, addressed to the small businessman who often is unfamiliar with the complexities of computers. The purpose is to provide guidance to enable the businessman to evaluate objectively when the computer is economical for his own needs, and then how to proceed.

The first two parts discuss questions relating to when to implement a computer, and the last two parts discuss how to do so. Part 1 presented the concept of differential analysis in the context of a general discussion of costs, benefits, and affordability of computer implementation — as reviewed below. Part 2 utilizes these concepts to analyze a specific business. Part 3 will discuss the selection and optimization of hardware and software, and Part 4 will describe the actual implementation in terms of both capabilities to be utilized and safeguards to be observed.

REVIEW OF PART 1 — General Economics of Computer Implementation

The most important review aspect of Part 1 was the concept of differential analysis, whereby the projected differences in cash flow resulting from the computer implementation may be described in comparison to no implementation. Definitions of differential revenue, expenditure, and cash flow were given. Additionally defined was the differential accumulated cash resulting from the differential cash flow over a specified time interval.

The general economic effects thus described consisted of a differential accumulated cash which would decline to a substantial negative value for several quarters as the computer costs accumulated without compensating benefits. Subsequently, as benefits became available, the differential accumulated cash would cease declining, then reverse itself toward the zero, or amortization, point, then continue to rise rapidly with time.

Several especially interesting features appeared in the analysis. The most surprising was the realization that any delay could have necessary and permanent costs, creating a high-risk aspect for the option of NOT computerizing. Additionally, the computer was viewed as an investment which was necessarily viable in the sense of amortizing itself. The only question was one of affordability, in the sense of whether the business could sustain the first several quarters of negative differential accumulated cash. If computerizing were not affordable, the business would sustain the differential losses as an unfortunate consequence of under-capitalization.

Part 1 also gave a detailed analysis of the most favorable conditions of affordability, achieved by an appropriate balance of differential revenue and differential expenditure. The estimates of optimum hardware costs ranged from $7,000 to $10,000, packaged software costs were about $2,000, and custom programming costs were about $600 per month for a year. The estimates of benefits included a saving of ½ to 5 employees and a 2%-10% increase in gross profits.

INTRODUCTION TO PART 2

The concepts, perspectives, and detailed costs and benefits described in Part 1 could be extended and applied to any small business. An example of such an application is now given, comprising this part of the series.

The first section specifies the hypothetical business data, such as business activity and financial and tax parameters, together with a set of computer costs and benefits — all with dollar values.

The second section differentially analyzes this business data with the aid of tables and graphs. The specific economic effects upon the business are then evaluated in terms of both cash and non-cash quantities such as net worth.

The third section extends the differential analysis concept to include a complete differential general ledger, including differential assets, liabilities, and equity.

The fourth section describes consideration for applying the analysis to real businesses instead of hypothetical ones. Finance costs, credit limits, return on investment, and utilization of capital are discussed, as are also the roles of intuition and common sense.

SPECIFICATION OF THE HYPOTHETICAL BUSINESS

Define the hypothetical business to be a small incorporated retail store with a quarterly gross receipts of $75,000 and with quarterly expenditures, including all salaries, amounting to $69,750, leaving $5,250 net profit. Let the business revenues and expenditures both grow at 2.5% per quarter without the computer.

Assume that the merchandise inventory is $60,000, also growing at 2.5% per quarter, and let $20,000 of this inventory be financed at a 15% annual percentage rate. The total equity of the business is assumed to be solely non-$3,500. The custom programming will be acquired at half time over a period of six months.

Additionally, the computer was viewed as an investment which was necessarily viable in the sense of amortizing itself. The only question was one of affordability. . .whether the business could sustain the first several quarters of negative differential accumulated cash.

Let the business employ five persons for clerical, sales, shipping, and bookkeeping duties, each having a salary of $600 per month. Suppose also that highly liquid equity investment funds are used to generate interest on those cash reserves that the business cannot absorb effectively. At the time of computer installation, let there by equity fund reserves of $6,000, an excess cash reserve of $1,000, and a credit reserve of zero.

The costs of computer implementation will be similar to those specified in Part 1, except for an economy emphasis. The hardware cost will be $6,000, and the software cost will be $1,000. Also assume that custom programming will be limited to three man-months for a total cost of $4,500. The business will acquire the $7,000 worth of hardware and packaged software on a lease-purchase plan with a 10% deposit and a $175 per month payment for three years. The business will exercise the purchase option after three years with a payment of $3,500. The custom programming will be acquired at ½ time over a period of six months.

The economic benefits expected from the computer also will be similar to those discussed in Part 1, except that they will become active gradually, at a linearly increasing amount, throughout the year interval after custom programming is completed. Specifically, it is projected that the computer will save labor in invoicing, billing, posting, and inventory control — ultimately in

DIFFERENTIAL REVENUES

SALES EFFICIENCY (5% increase in sales @ same overhead)

DATE (QTR)	NOTES	NO computer revenue	NO computer expenditure	NO computer cost of goods sold	NO computer overhead	NO computer profit	WITH computer revenue	WITH computer cost of goods sold	WITH computer expenditure	WITH computer profit	differential revenue (profit)
0	Computer Installation	75000	69750	45000	24750	5250	75000	45000	69750	5250	0
1	Programming-No Benefit	76875	71494	46125	25369	5381	76875	46125	71494	5381	0
2		78797	73281	47278	26003	5516	78797	47278	73281	5516	0
3	Benefit=1.25% of sales	80767	75113	48460	26653	5654	81777	49066	75719	6058	404
4	Benefit=2.5% of sales	82786	76991	49672	27319	5795	84856	50914	78233	6623	828
5	Benefit=3.75% of sales	84856	78916	50913	28003	5940	88038	52823	80826	7212	1272
6	Benefit=5.0% of sales	86977	80887	52186	28701	6090	91326	54796	83497	7829	1739
7		89151	82911	53491	29420	6240	93609	56166	85586	8023	1783
8		91380	84984	54828	30156	6396	95949	57570	87726	8223	1827
9		93665	87108	56199	30909	6556	98348	59009	89918	8430	1874
10		96006	89286	57604	31682	6720	100807	60485	92167	8640	1920
11		98406	91518	59044	32474	6888	103327	61997	94471	8856	1968
12		100867	93806	60520	33286	7061	105910	63547	96833	9977	2016
13		103388	96151	62033	34118	7237	108558	65135	99253	9305	2068
14		105973	98555	63584	34971	7418	111272	66764	101735	9537	2119
15		108622	101019	65173	35846	7603	114054	68433	104279	9775	2172
16		111338	103544	66803	36741	7794	116905	70144	106885	10020	2226

TABLE 1

LABOR SAVINGS (1 employee)

DATE (QTR)	NOTES	NO computer labor cost	WITH computer labor cost	differential revenue (labor)
0	Computer Installation	9000	9000	0
1	Programming-No Benefit	9000	9000	0
2		9000	9000	0
3	Benefit=1/4 person	9000	8550	450
4	Benefit=1/2 person	9000	8100	900
5	Benefit=3/4 person	9000	7650	1350
6	Benefit= 1 person	9000	7200	1800
7		9000	7200	1800
8		9000	7200	1800
9		9000	7200	1800
10		9000	7200	1800
11		9000	7200	1800
12		9000	7200	1800

TABLE 2

MANAGEMENT EFFICIENCY 3% decrease in overhead @ same revenue

DATE (QTR)	NOTES	revenue	cost of goods sold	NO computer expenditure	NO computer overhead	WITH computer overhead	differential revenue (overhead)
0	Computer Installation	75000	45000	69750	24750	24750	0
1	Programming-No Benefit	76875	46125	71494	25369	25369	0
2		78797	47278	74281	26003	26003	0
3	Benefit=.75% of overhead	80767	48460	75113	26653	26453	200
4	Benefit=1.5% of overhead	82786	49672	76991	27319	26909	410
5	Benefit=2.25% of overhead	84856	50913	78916	28003	27373	630
6	Benefit=3.0% of overhead	86977	52186	80887	28701	27840	861
7		89151	53491	82911	29420	28537	883
8		91380	54828	84984	30156	29250	906
9		93665	56199	87108	30909	29982	927
10		96006	57604	89286	31682	30731	951
12		98406	59044	91518	32474	31500	974
13		100867	60520	93806	33286	32287	999
14		103388	62033	96151	34118	33094	1024
15		105973	63584	98555	34971	33922	1049
16		108622	65173	101019	35846	34770	1076
17		111338	66803	103544	36741	35639	1102

TABLE 3

the amount of one employee. Project also that improved inventory management, enabled by an analysis of past and present sales, will increase turns ratio by 20% over the year interval. Sales management also will improve by using an analysis of sales personnel performance and advertising effectiveness, together with motivational programs and client follow-ups. Assume that, without an increase in overhead, an increase of 5% of gross receipts can be efected over and above the normal growth of the business without the computer. Additionally, it is anticipated that improved task management will increase operating efficiency — or reduce overhead without affecting sales. This might be achieved through elimination of non-essential tasks, through achievement of deadlines and payment schedules, and through utilization of improved financial strategies enabled by analysis of business activity and potentials. Assume that overhead is reduced by 3% ultimately, in comparison to the non-computer option, without affecting sales.

These costs and benefits are typical of what the average businessman might encounter and expect with a computer implementation. The next step is to analyze this raw data to evaluate the economic impact upon the business and ultimately to determine the affordability of the computer.

ANALYSIS OF THE BUSINESS

Differential analysis is now applied to this data. As discussed in Part 1, differential revenues, expenditures, cash flow, and accumulated cash must be calculated. Such calculations are now presented, supported by Tables 1 through 8, and depicted by Figures 1 and 4.

Differential Revenue

The major categories of differential revenue, as described above, are revenues from improved sales efficiency, labor savings, improved management efficiency, and increased inventory management — indicated in Tables 1 through 4, respectively. In each table is given the option of NO-COMPUTER which is used as the baseline against which the WITH-COMPUTER option is measured. The date is specified by quarter number, Qn, where n represents the data at the end of quarter n after the installation of the computer at Q0.

The sales efficiency table, Table 1, first establishes business parameters for the NO-COMPUTER option. The revenue increases at 2.5% per quarter, as specified earlier. The net profit is established at 7% of gross revenue (5,250/75,000), and the expenditure therefore at 93% of revenue. The cost of merchandise is 60% of retail, thus cost of goods sold is 60% of revenue. The overhead is calculated as the difference between expenditures and cost of goods sold. The WITH-COMPUTER option is then calculated, with the revenue remaining identical to the NO-COMPUTER option until programming is completed. As the computer is phased into operation, sales efficiency increases linearly each successive quarter during the following year interval. The difference in revenue over the NO-COMPUTER option starts with a 1.25% difference at the end of the third quarter (at Q3), and ends with a 5% difference at the end of the sixth quarter (at Q6). The cost of goods sold is calculated at 60% of the improved revenue, and overhead remains identical to the NO-COMPUTER option. The expenditure is then calculated as the sum of overhead and cost of goods sold, whence profit for the WITH-COMPUTER option is calculated. The differential revenue is the improvement in profit from using the computer, indicated in the last column.

The labor savings are presented in Table 2, depicting the cost of labor such as clerical, bookkeeping, sales, and shipping personnel. At the salary of $600 per month for five employees, the quarterly costs are $9,000 with the NO-COMPUTER option. The WITH-COMPUTER option assumes no labor savings until after custom programming, similar to the previous analysis. Also, similarly, the labor savings increase linearly throughout the following year interval, starting with ¼ employee at Q3, and ending with a 1 employee savings at Q6. The differential revenue is the difference in labor costs for each quarter.

Table 3 depicts the effects of management efficiency, whereby revenues with both the NO-COMPUTER and WITH-COMPUTER options remain identical, but whereby the overhead ultimately drops 3% from using the computer. In this calculation, the revenue, cost of goods sold, expenditure, and overhead for the NO-COMPUTER option are, of course, identical to those of Table 1. The WITH-COMPUTER option shows the linear decline in overhead over the year interval, starting with a .75% decline at Q3 and ending with a 3% decline at Q6. The differential revenue is the reduced overhead resulting from computerizing.

The last differential revenue considered results from improved inventory management as depicted in Table 4. The inventory at Q0 is $60,000, and in the NO-COMPUTER option this amount increases with the growth of the business at 2.5% per quarter. The turns ratio is the cost of goods sold divided by inventory, or a constant .75 units per quarter. In the WITH-COMPUTER option, the inventory turns ratio is increased linearly, starting with a 5% increase at Q3, and ending with a 20% increase to .90 units per quarter at Q6. The calculation of inventory is given by the formula (inventory) = (cost of goods sold)/(turns ratio). The cash released in this process is then invested in a highly liquid INVENTORY equity fund returning 15% annual percentage rate. This interest income represents the differential revenue, since it could not have been collected without the improved inventory management. Note that, for illustration, the interest on

INVENTORY MANAGEMENT — 20% increase in turns ratio

DATE (QTR)	NOTES	NO computer: inventory value	WITH computer: inventory value	WITH computer: inv. equity fund	WITH computer: interest	differential revenue (interest)
0	Computer Installation	60000	60000	0	0	0
1	Programming-No Benefit	61500	61500	0	0	0
2	↓	63038	63038	0	0	0
3	Benefit=5% turns ratio	64613	61536	3077	0	0
4	Benefit=10% turns ratio	66229	60208	6021	115	115
5	Benefit=15% turns ratio	67884	59030	8854	226	226
6	Benefit=20% terms ratio	69582	57985	11597	332	332
7		71321	59434	11887	435	435
8		73104	60920	12184	446	446
9		74932	62443	12489	457	457
10		76805	64004	12801	468	468
11		78725	65604	13121	480	480
12		80693	67244	13449	492	492
13		82711	68925	13786	504	504
14		84778	70648	14130	517	517
15		86898	72415	14483	530	530
16	↓	89070	74225	14845	543	543

TABLE 4

DIFFERENTIAL EXPENDITURE

COST OF COMPUTER & PROGRAMMING		lease purchase @ $175/month & 6-month custom programming @ half time								
			WITH computer							
			costs				offsets to costs			
DATE (QTR)	NOTES	NO computer costs	hardware	custom software	property tax	TOTAL	expense tax deductions	investment tax credit	depreciation credits	NET differential expenditure
0	Computer Installed									
	Deposit Paid	0	-700	0	0	-700	0	0	0	-700
1	Lease Payment + 1/2									
	Time Programming	0	-525	-2250	0	-2775	+694	0	0	-2081
2		0	-525	-2250	0	-2775	+694	0	0	-2081
3		0	-525	0	0	-525	+131	0	0	-394
4		0	-525	0	0	-525	+131	0	0	-394
5	lease payments	0	-525	0	0	-525	+131	0	0	-394
6		0	-525	0	0	-525	+131	0	0	-394
7		0	-525	0	0	-525	+131	0	0	-394
8		0	-525	0	0	-525	+131	0	0	-394
9		0	-525	0	0	-525	+131	0	0	-394
10		0	-525	0	0	-525	+131	0	0	-394
11		0	-525	0	0	-525	+131	0	0	-394
12		0	-525	0	0	-525	+131	0	0	-394
13	Pur. Option+Maint.	0	-3575	0	-32	-3607	+27	+70	+53	-3457
14	Maintanance	0	-75	0	-32	- 107	+27	+70	+53	+43
15		0	-75	0	-32	- 107	+27	+70	+53	+43
16		0	-75	0	-32	- 107	+27	+70	+53	+43

TABLE 5

the sum in the equity fund is collected in each quarter succeeding the deposit quarter, rather than in the deposit quarter itself.

Differential Expenditure

The differential expenditures are limited to one category in this hypothetical business — the direct cost of acquisition of the computer capability, as depicted in Table 5. Both hardware and custom software are included.

At this point, plus and minus signs have been introduced. The convention used here, and throughout the discussion, is that a plus sign indicates a flow of cash or equity into the business from the outside world, irrespective of the labels or column headings. A minus sign represents the opposite flow from the business to the outside.

The NO-COMPUTER option simply consists of zero entities, emphasizing the fact that it is a baseline reference. The WITH-COMPUTER option assumes a lease-purchase arrangement for the hardware and packaged software. The deposit is $700, and monthly lease payments are $175 per month. After three years, the option to purchase is exercised with an extra payment of $3500 such that this sum plus the initial deposit represent the $4200 depreciated value of the computer after three years. The custom programming is paid over a period of six months at the half-time rate of $750 per month. (The $600 per month rate specified in Part 1 was based upon a longer contract.)

Note that the lease payments and programming costs were considered expenses for the purposes of tax deductions, as shown in table 5. The business is assumed to be in an effective 25% tax bracket. Also note that an income tax investment credit of $280 is taken at the time of purchase of the computer, spread over the four following quarters. Similarly taken are depreciation credits. After purchase, additional expenses are incurred for property tax and maintenance, although these are reduced as expenses by the 25% tax rate.

These computer acquisition arrangements are illustrative of one choice among a variety of possibilities, such as outright purchase, financed purchase, leases without purchase options, and leases with other time periods. Alternative custom programming options may include different total amounts of programming and pacing. Such choices are determined by questions of affordability, of optimizing impact upon accounting ledgers in both the short term and long term, and of other more subjective factors. Tax considerations may be especially important, as, for example, the fact that custom programming may be considered a non-tangible asset to build equity, rather than an expense.

Differential Cash Flow and Differential Accumulated Cash

The foregoing calculations of differential revenues and expenditures are summarized in Table 6 and Figures 1 and 2. Note that the differential cash flow and differential accumulated cash resemble their generalized counterparts in Part 1, except that they now represent a specific business with real projections and that they have a faster amortization.

The differential revenues listed in Table 6 are taken from Tables 1-4. The sum of these quantities is then calculated and reduced by the 25% tax rate to be consistent with the differential expenditures taken from Table 5. The differential cash flow is the sum of differential revenue and expenditures, observing the sign con-

DIFFERENTIAL CASH FLOW & DIFFERENTIAL ACCUMULATED CASH

DATE (QTR)	NOTES	DIFFERENTIAL REVENUE					differential expenditure	differential cash flow	differential accumulated cash	GP equity fund interest previous quarter incl. taxes	differential accumulated cash including interest	differential accumulated cash delayed 2 quarters	cost of delay
		sales efficiency	labor savings	management efficiency	inventory management	TOTAL less 25% taxes	TOTAL						
0	Computer Installed	0	0	0	0	0	-700	-700	-700	0	-700	0	+700
1	Lease + 1/2 time												
	No Benefit	0	0	0	0	0	-2081	-2081	-2781	-26	-2807	0	+2807
2	↓	0	0	0	0	0	-2081	-2081	-4862	-104	-4992	-700	+4292
3	Lease + Benefits	404	450	200	0	792	-394	+398	-4465	-182	-4778	-2807	+1971
4		828	900	410	115	1689	-394	+1295	-3170	-167	-3650	-4992	-1342
5		1272	1350	630	226	2609	-394	+2215	-955	-119	-1554	-4778	-3224
6		1739	1800	861	332	3549	-394	+3155	+2200	-36	+1565	-3650	-5215
7		1783	1800	883	425	3676	-394	+3282	+5482	+83	+4930	-1554	-6484
8		1827	1800	906	446	3734	-394	+3340	+8822	+206	+8476	+1565	-6911
9		1874	1800	927	457	3794	-394	+3400	+12222	+331	+12207	+4930	-7277
10		1920	1800	951	468	3854	-394	+3460	+15682	+458	+16125	+8476	-7649
11		1968	1800	974	480	3917	-394	3523	+19205	+588	+20236	+12207	-8029
12	↓	2016	1800	999	492	3980	-394	+3586	+22791	+720	+24542	+16125	-8417
13	Purchase + Maint.	2068	1800	1024	504	5047	-3457	+590	+23381	+855	+25987	+20236	-5751
	and Benefits												
14	Maint. + Benefits	2119	1800	1049	517	4114	+43	+4157	+27538	+877	+31021	+24542	-6479
15		2172	1800	1076	530	4184	+43	+4227	+31765	+1033	+36281	+25987	-10294
16	↓	2226	1800	1102	543	4253	+43	+4296	+36061	+1191	+41768	+31021	-10747

TABLE 6

ventions already stated. The differential accumulated cash is a cumulative total of cash flow. It is assumed that this accumulated cash is invested in a GENERAL PURPOSE equity fund returning an interest at 20% APR. Note that this is a higher return than the INVENTORY equity fund because of less stringent requirements of liquidity. For each quarter, the equity fund interest is calculated on the cash accrued in the previous quarter and is then reduced by the 25% tax rate before being entered into the table. This net interest after taxes is then used to create a corrected version of the differential accumulated cash.

The cost of delay is calculated by comparing the accumulated differential cash with the identical quantity delayed by two quarters. The comparison is calculated such that a plus sign indicates a cash surplus by DELAYED computerizing, and minus sign indicates a cash deficit, as depicted in Figure 3. In this example, the cost of delay exceeds $5,000 per quarter of delay — evaluated after four years.

The net profits after taxes are shown in Table 7 and Figure 4. The profits of the NO-COMPUTER option are taken from those of Table 1, then reduced by the 25% tax rate to be consistent with the differential cash flow in Table 6. The WITH-COMPUTER option is calculated by adding the differential cash flow, equity fund interest, and NO-COMPUTER profits. Note that net profits are nearly doubled in this business with the computer.

The equity fund interest was not included in the differential cash flow, since its calculation utilized the differential cash flow itself. A new differential cash flow could be defined, of course, to include the equity fund interest — but this would create the same differential accumulated cash as the corrected accumulation in Table 6.

PROFITS

DATE (QTR)	NET PROFITS AFTER TAXES @ 25%		% change in net profits
	NO computer	WITH computer (incl. interest)	
0	3938	3238	-18%
1	4036	1929	-52%
2	4137	1952	-53%
3	4240	4456	+5%
4	4346	5474	+26%
5	4455	6551	+47%
6	4566	7685	+68%
7	4680	8045	+72%
8	3797	8343	+74%
9	4917	8648	+76%
10	5040	8958	+78%
11	5166	9277	+80%
12	5295	9601	+81%
13	5428	6873	+27%
14	5564	10598	+90%
15	5703	10963	+92%
16	5845	11332	+94%

TABLE 7

The equity fund technique represents an extension of differential analysis to include cash equity other than a mere bank account, and also includes the concept of active cash manipulations. The differential accumulated cash must be either absorbed or supplied by the cash equity of the business, depending upon sign. The equity fund is ideal for this purpose so that interest may be lost or collected at an APR of 15% to 20% or higher. In reality, this equity fund may take the form of various financing arrangements, investments in stocks and bonds, repayment or utilization of business loans, or investment in the business itself. In this example, the business return on investment is 52.5%. If the business could absorb capital with maintenance of its ROI, then it could be considered as an available equity fund with a 52.5% APR, replacing the 20% equity fund used in this analysis. Indeed, one activity of business is the use of a negative equity fund (business loan) to generate funds to invest in another equity fund at a higher return (the business itself).

A complete projected *differential general ledger* may be created, as also may be a complete *differential business* with its own set of double-entry journals including accounts receivable, accounts payable, general ledger, and inventory.

A further extension of differential analysis to non-cash quantities is considered with the equity of the computer after purchase at Q13, as portrayed in Figures 2, 3, and 4. This extension is fully developed in the next section describing the differential general ledger.

THE DIFFERENTIAL GENERAL LEDGER & DIFFERENTIAL BUSINESS

The differential analysis explained thus far gives a fairly clear picture of the cash impact of implementing a computer, and also slightly extends the concept to accommodate cash manipulations and equity.

These slight extensions suggest the possibility of a comprehensive differential analysis not only for cash flow, but also for assets, liabilities, and equity & net worth. A complete projected *differential general ledger* may be created, as also may be a complete *differential business* with its own set of double-entry journals including accounts receivable, accounts payable, general ledger, and inventory. Such differential analyses may be created for each option being considered by the businessman, evaluating both short term and long term effects upon the business. They may be compared or combined in any desired manner, creating a powerful tool useful for precise comparisons of a multitude of possibilities. Since these calculations could become quite complex, here is an example of where the computer itself could be employed as a tool for management decisions.

A differential general ledger is illustrated in Table 8. Note that it provides a natural tool for calculating equity, interest, investment, tax credits, property taxes, depreciation, returns on investment, and other subtleties which need to be included. The format is far more coherent than the Tables 1 through 7, even though the tables are sufficient.

The entries in the differential general ledger are chosen to be consistent with the tables. For example, note that within each quarter the sum of the GP equity fund entries is identical to the differential cash flow of Table 6 for the corresponding quarter. The accumulated sums throughout the quarters is identical to the differential accumulated cash. If the interest on the GP equity fund, entered in the bank account, is included, then the corrected differential accumulated cash of Table 6 is achieved. The net worth and profits include the equity of the initial deposit and computer purchase, consistent with Figures 2, 3, and 4.

The calculations of Tables 1 through 5 are reproduced in each quarter individually, as labeled. The NO-COMPUTER reference values of sales, overhead, and inventory — as required in the calculations for each quarter— are taken from the NO-COMPUTER values for the corresponding quarter listed in Tables 1 and 4.

Note that the differential general ledger highlights certain omissions in the table calculations. One example is that the interest on the GP equity fund is entered in the bank to be consistent with the tables, but could have been entered in the GP equity fund itself — collecting interest on the interest.

As indicated above, the differential G/L can incorporate effects of each quarter upon successive quarters. These effects are not easily incorporated into tables. A hint of the difficulty can be given by observing that the growth rate of revenue in the WITH-COMPUTER option in Table 1, for quarters 3 through 6, is not exactly the expected 2.5% per quarter. Ideally, all costs and benefits would be defined self-referentially in terms of current operating parameters, rather than in terms of an external reference of unused operating parameters, such as the NO-COMPUTER reference used here to calculate the WITH-COMPUTER option. In such a case, the sales, expenditures, overhead, and inventory all would be accumulated quarter by quarter such that all effects of previous quarters would compoundly accumulate, with amounts quite different from the NO-COMPUTER option as used here. The costs and benefits then would be defined in terms of these amounts, rather than by using the NO-COMPUTER references.

However, the description of such a self-referential differential G/L is beyond the scope of this discussion. Fortunately, the extra accuracy of second-order effects is negligible except in cases of rapid growth rates, high return rates, or high interest rates. A clever use of the simpler externally-referenced differential G/L of Table 8 can accommodate simultaneous and accumulative effects, given proper choice of the external reference.

One important feature of a differential G/L is that it renders the impact of decisions quite visible, not camouflaged by irrelevant numbers — it "pulls the signal out of the noise." It also provides the data for employing powerful mathematical techniques. Partial differential equations may be used to study and optimize interactive and combinatorial effects of multiple simultaneous options. The calculus of variations may be used to determine optimum strategies and timing of manipulations as time progresses.

Although such techniques are much more sophisticated than necessary in the small business, they emphasize the power and potential of the differential business concept.

CONSIDERATIONS FOR SPECIFIC BUSINESSES

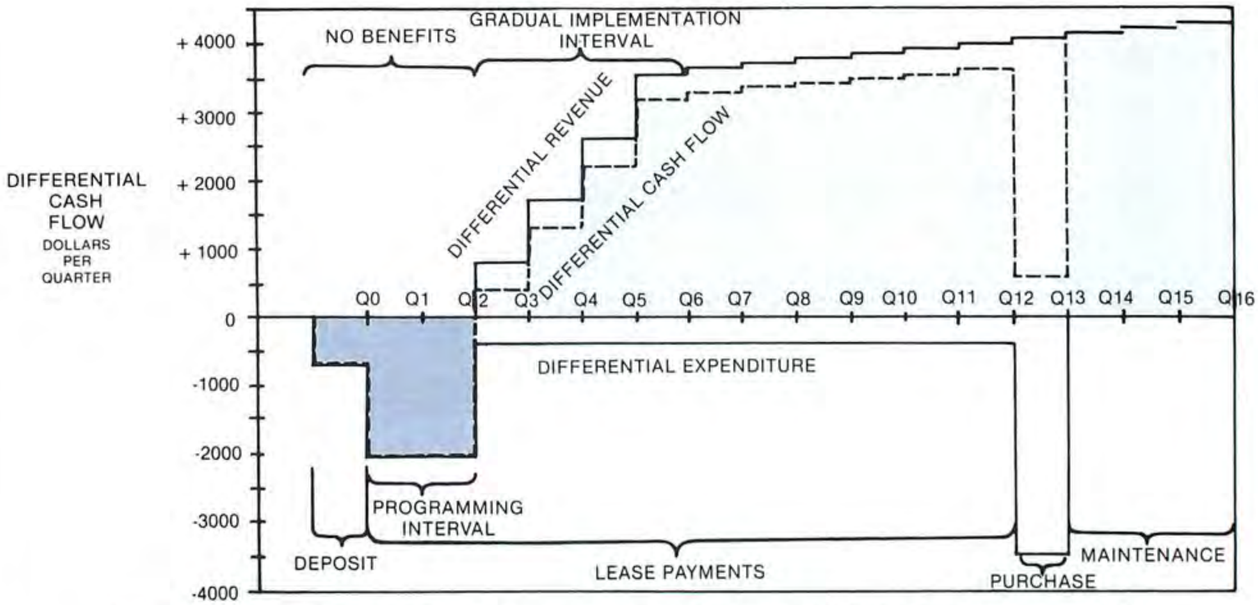
This hypothetical business analysis is an example of the method of calculating overall economic effects, on the assumption that each contributing expected cost

DIFFERENTIAL GENERAL LEDGER

WITH-computer
vs
NO-computer

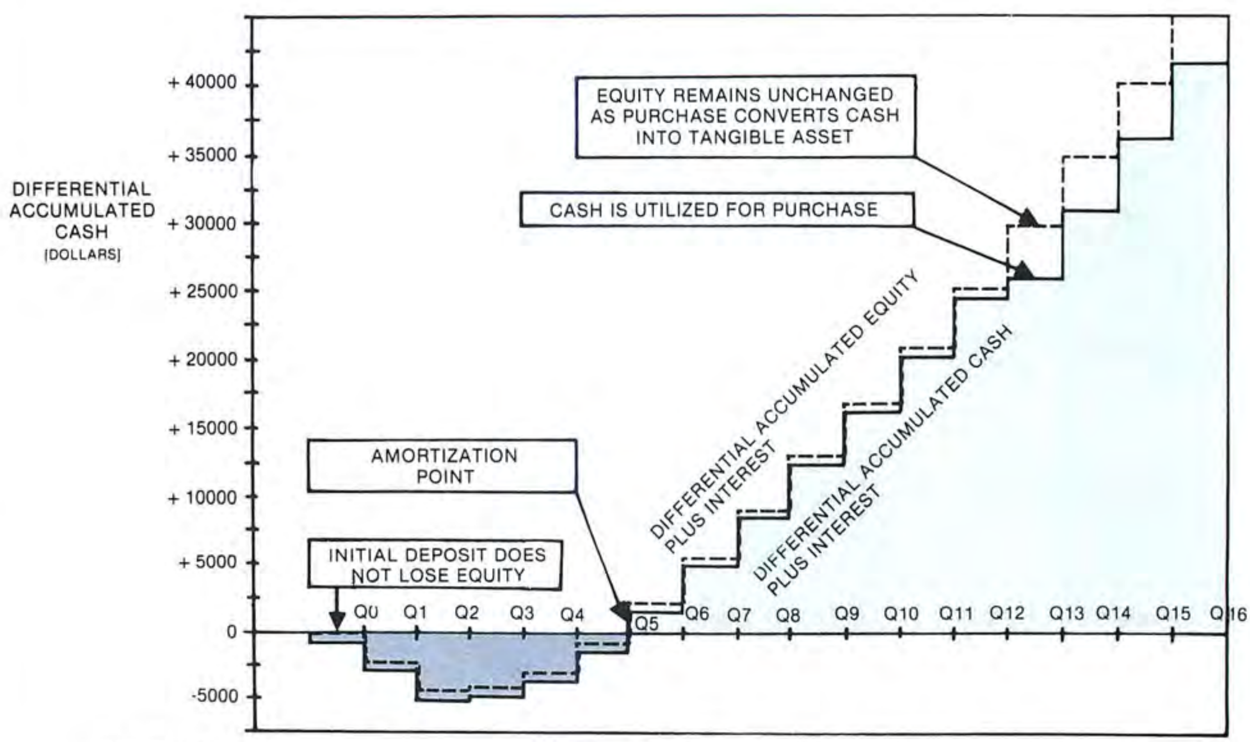
DATE	TRANSACTION: TYPE	TRANSACTION: DESCRIPTION	LIAB: NOTES PAYABLE	ASSETS: CASH: bank	ASSETS: CASH: GPequity fund	ASSETS: inv.equity fund	ASSETS: computer capital assets + deposits	ASSETS: mdse inventory	NET WORTH & PROFITS	DIFFERENTIAL REVENUES: COMPUTER-GENERATED: interest on inv equity fund	COMPUTER-GENERATED: increase in sales	COMPUTER-GENERATED: decrease in labor costs	COMPUTER-GENERATED: decrease in overhead	TAX-SAVINGS: depreciation credits	TAX-SAVINGS: expense deductions	TAX-SAVINGS: investment credits	INTEREST ON GP EQUITY FUND	DIFFERENTIAL EXPENDITURES: INTEREST LOST IN NOTES PAYABLE	INCREASE IN COST OF GOODS SOLD	INCREASE IN OVERHEAD	COMPUTER—CREATED: hardware	COMPUTER—CREATED: custom software	COMPUTER—CREATED: property tax	COMPUTER—CREATED: depreci-ation
Q0	computer	deposit for lease			-700		+700		0															
Q1	adjust	interest on GP		-26					-26					+9		-35								
		equity fund for																						
		previous quarter																						
Q1	computer	lease + program-			-2081				-2081					+694							-525	-2250		
		ming																			-525	-2250		
Q1		DIFFERENTIAL		-26	-2781		+700		-2107					+703		-35								
		ACCUMULATION																						
Q2	adjust	interest on GP		-104					-104					+35		-139								
		equity fund for																						
		previous quarter																						
Q2	computer	lease + program-																						
		ming			-2081				-2081					+694							-525	-2250		
Q2		DIFFERENTIAL		-130	-4862		+700		-4292					+1432		-174					-1050	-4550		
		ACCUMULATION		-130	-4862		+700		-4292					+1432		-174								
Q3	computer	lease only			-394				-394					+131							-525	0		
Q3	adjust	interest on GP		-182					-182					+61		-243								
		equity fund for																						
		previous quarter																						
Q3	computer	1.25% increase in			+303				+303		+1010			-101					-606	0				
		sales@ 80767																						
		(no ovhd increase)																						
Q3		labor savings @			+337				+337			+450		-113										
		1/4 employee																						
Q3		.75% decrease in			+150								+200	-50										
		overhead @ 26653																						
Q3		5% increase in 48460																						
		turns ratio @ 64613				+3077		-3077	0															
Q3		DIFFERENTIAL		-312	-4466	+3077	+700	-3077	-4078		+1010	+450	+200	+1360		-417			-606	0	-1575	-4500		
		ACCUMULATION																						
Q4	computer only	lease only			-394				-394					+131							-525	0		
Q4	adjust	interest on GP		-167					-167					+56		-223								
		equity fund for																						
		previous quarter																						
Q4		interest on INV			+86				+86	+115					-29									
		equity fund of																						
		previous quarter																						
Q4	computer	2.5% increase in			+621				+621		+2070				-207				-1242	0				
		sales @ 82786																						
		(no ovhd increase)																						
Q4		labor savings			+675				+675			+900			-225									
		1/2 employee																						
Q4		1.5% increase in																						
		overhead @ 27319			+307				+307				+410		-103									
Q4		10% increase in 49672				+6021		-6021	0															
		turns ratio @ 66229				+6021		-6021	0															
Q4		DIFFERENTIAL		-479	-3171	+9098	+700	-9098	-2950	+115	+3080	+1350	+610	0	+983	0	-640	0	-1848	0	-2100	-4500	0	0
		ACCUMULATION																						
		ETC.																						

TABLE 8



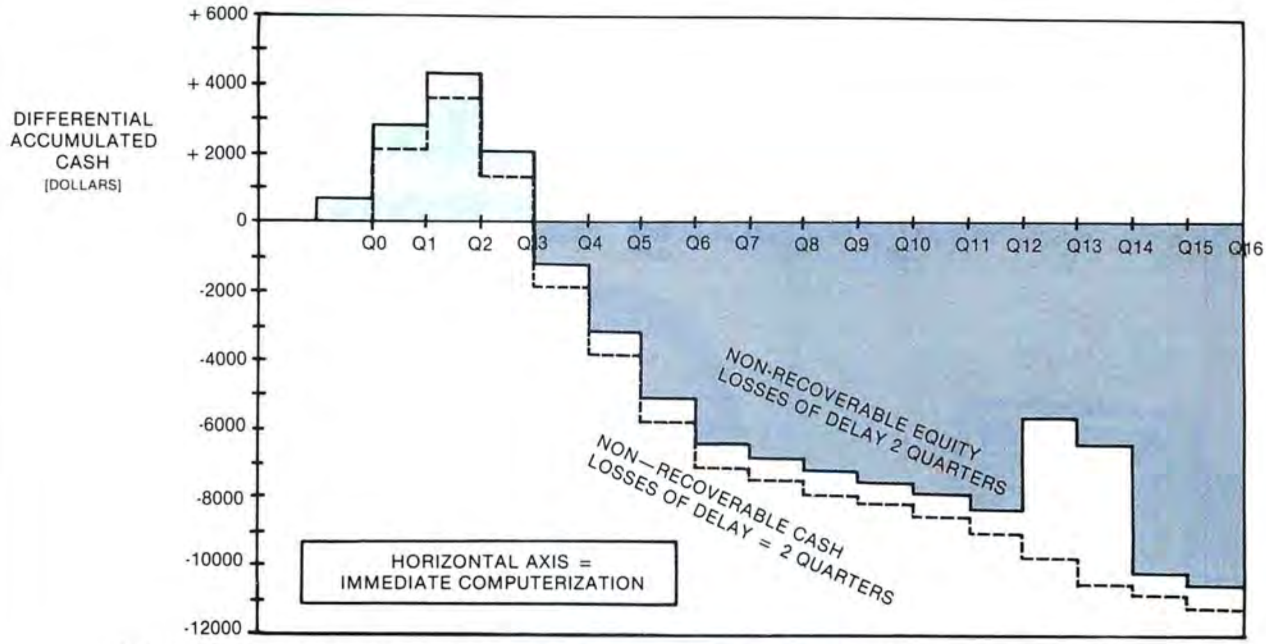
This graph shows the differential revenue, expensiture, and cash flow indicated in Table 6, in which an assumed 25% tax compensation is included in all calculations. Quantities accrued by the end of each quarter are assumed to be operational throughout the quarter for purposes of defining cash flow and calculating interest and return on investment.

Figure 1. Differential Cash Flow



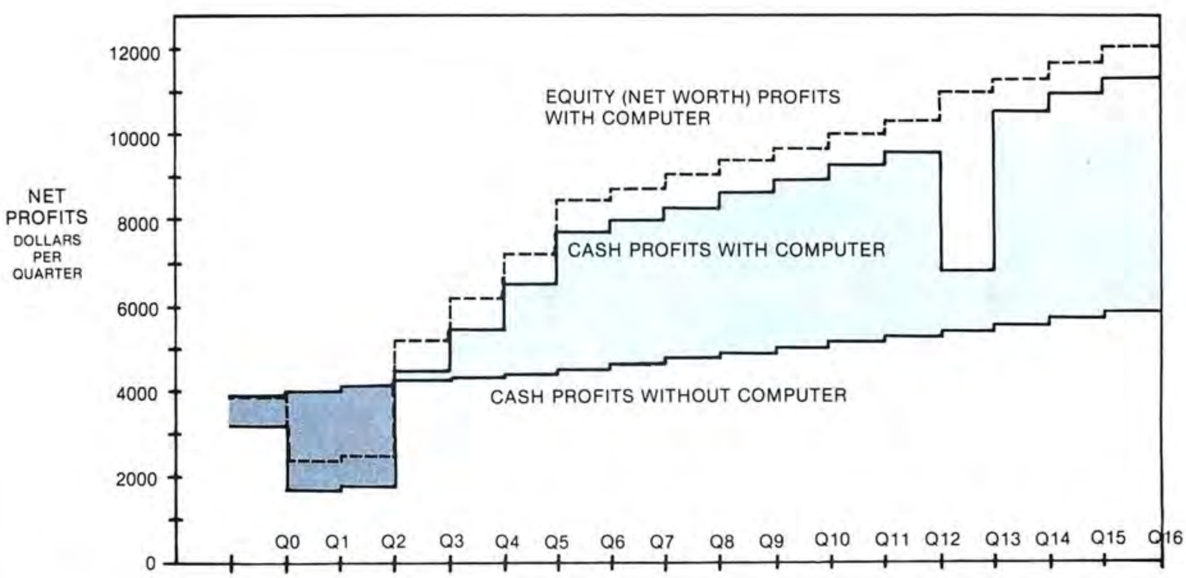
This graph shows differential accumulated cash and equity for the cash flow of Figure 1 plus interest. Quantities accrued by the end of each quarter are assumed to be operational throughout the quarter for the purposes of calculating interest and return on investment. Note that the initial deposit and the later purchase create no equity losses. Without including interest, both curves would remain slightly nearer 0 (See Table 6).

Figure 2. Differential Accumulated Cash



The cost of delay, as calculated in Table 6, is a non-recoverable deficit in differential accumulated cash, which is actually NET PROFITS before taxes. This deficit continually deepens as the business grows, emphasizing the high-risk nature of delay. The cost of delay exceeds $4,000 per quarter of delay.

Figure 3. Cost of Delay



Net profits after taxes are depicted, assuming a 25% tax rate, as calculated in Table 7. Equity (net worth) profits consider the initial deposit and subsequent purchase price as tangible assets converted from cas. Note that the net profits in the computer option are nearly double those of the no-computer option. This increase in profits is greater than the differential cash flow of Figure 1, since the interest on the differential accumulated cash is additinally included. (See text)

Figure 4., Net Profits

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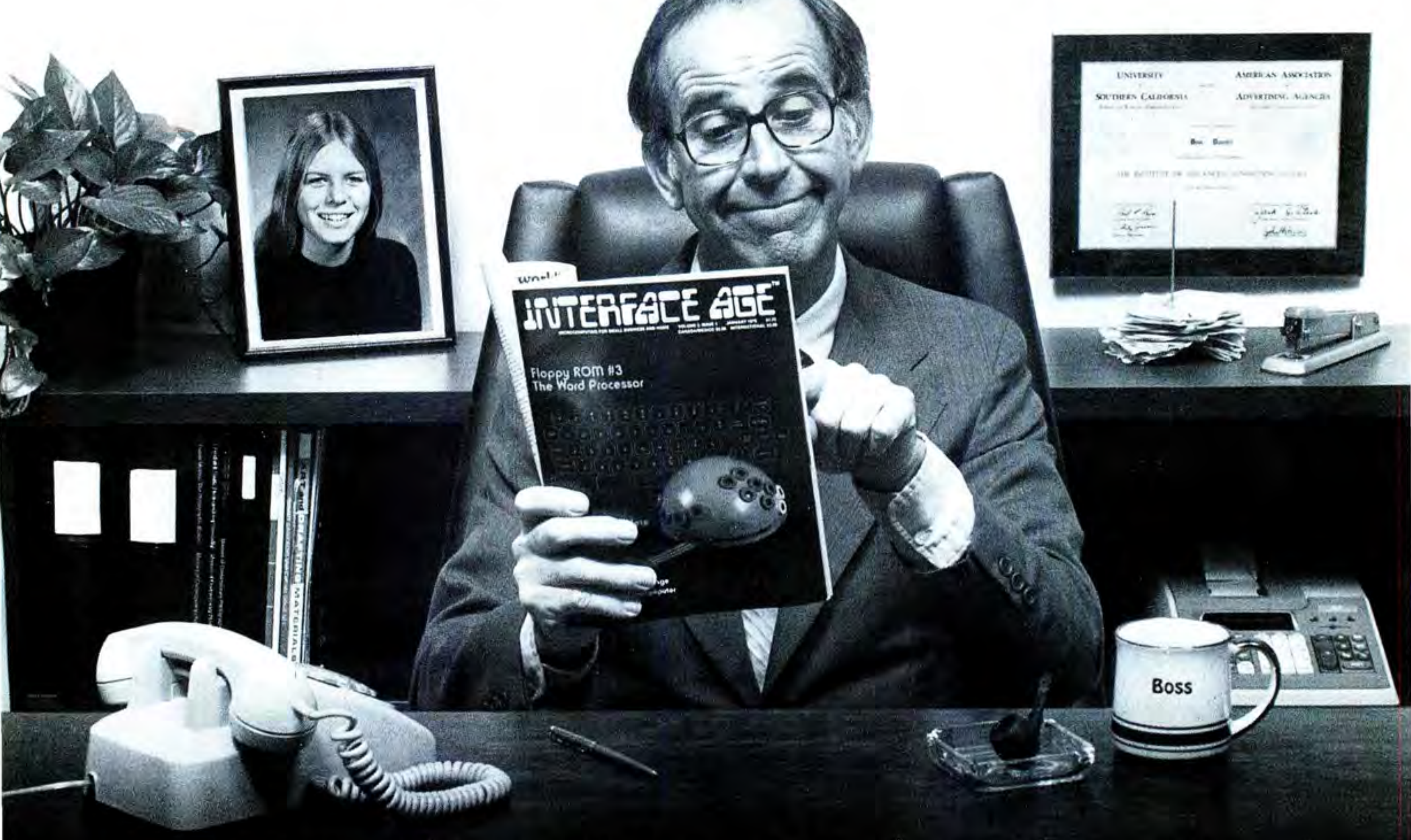

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and benefit is already known. The determination of these factors is a highly individual matter, depending upon the details of the business finances and organizational workload and inefficiencies.

The factors of cost are reasonably well-bracketed in total price of hardware and software, as emphasized in Part 1, but there are several techniques of computer acquisition mentioned earlier, each of which may have radically different impacts upon the business finances, and may require a preliminary differential analysis to evaluate and select the appropriate option. Such a preliminary analysis, for example, might not include differential revenues which remain unchanged because of unchanging computer capabilities.

Leasing arrangements are often much more affordable because of the small initial cost of expendable capital and minimal effect upon credit limits. . .

Among the many factors that need to be considered in a differential analysis are finance costs, return on investment, credit limits, utilization of capital, taxes, and other factors. For example, a cash outlay may be quite costly if the business is functioning at its credit limit and can absorb capital with maintenance of its return on investment. In the case of the hypothetical business described herein, such a cash purchase would cost an APR of 52.5%. Alternatively, a business may finance a purchase at less net cost than an outright purchase, if financing makes available cash which can be invested at a return higher than the financing interest rate. If such a purchase contains equity, the equity may increase the credit limit of the business for further financing and investment, an effect especially desirable if the business is at its credit limit.

Tax considerations are especially important. For example, a purchase benefits from investment tax credits and depreciation credits, but loses by property taxes, actual depreciation costs, cost of capital, and possible finance costs. Leasing arrangements are often much more affordable because of the small initial cost of expended capital and minimal effects upon credit limits, but leasing also bears higher effective interest rates, non-availability of investment tax credits (except in special circumstances), and no depreciation credits.

In special cases such as custom programming, the immediate program purchase has a high initial cost of capital, offset by the immediate implementation of computer capabilities and benefits. The slow-paced options reduce initial capital requirements, but cause delayed differential revenue with the possible consequence of more costly net cash flow. Other special cases are common — any task which costs a premium to complete early, but which also returns benefits early.

The benefit factors are much more difficult to assess. For example, are the sales personnel already highly motivated and effective, or will an analysis of their performance provide motivation or enable motivational programs? Or, does the business advertise effectively, or not at all? What are the possibilities of evaluating return on advertising? Is the organization closely knit and functional, or is there lost effort and waste? Are payment deadlines met? Are potential clients ignored through lack of records and follow-ups? Are many personnel idle part of the time or engaged in low-priority tasks, especially at the expense of more important ones? How much effort is expended for keeping books? Is this effort efficient, or redundant? How much inventory is dead stock? What items are profitable? Are time or customers lost by not knowing backorder situations? How many accounts are losing money by being delinquent, and for how long? How much potential income is being lost by insufficient financial analysis.

These questions exemplify the kind of thinking which must be used to establish the dollar amounts of expected benefits from the computer. They are highly sensitive to individual situations, and evaluation requires the full business sense, both intuitive and objective, of the businessman. The secret, as illustrated in the foregoing analysis, is to break down the expected benefits into small, well-defined, and separate effects, then to combine these effects in a differential cash or general ledger analysis.

SUMMARY

A hypothetical business has been defined, the expected costs and benefits of computerizing established, and then the economic results of computerizing have been calculated in terms of differential cash flow. In addition to cash flow, the concepts of non-cash flow have been introduced via the differential general ledger and business, a tool which provides accurate calculations in a coherent manner, and which can be extended to accommodate interactive, combinatorial, and accumulative effects. In other words, the tools of calculation of total economic effect have been described and exemplified.

In addition, emphasis has been given to the intuition and creativity requirements of the individual businessman to define and estimate each of the many factors contributing to the costs and benefits of computerizing in a manner appropriate to each highly individual business. The differential analysis is only as good as the accuracy of estimated effects, and only considers those manipulations which the businessman creates. Analysis evaluates the options, but the businessman creates the options to evaluate.□

Patents, Copyrights and Computers

By Leonard Tachner
Patent Attorney

INTRODUCTION

There are, possibly, three types of protection for computer program related innovations, namely, patents, copyrights and trade secrets. I say, "possibly," because just how patents and copyrights can be used to protect computer programs or systems employing programmed computers is still not totally clear, as you will understand shortly. Programs do generally receive the protection of trade secrets when they are marketed with contract provisions prohibiting disclosure. Table 1 indicates in brief form the general characteristics of the three types of protection as well as specific considerations relating to software.

Before getting into the details, it would be useful to review these three types of protection in general terms so that you will have a better idea of how they differ.

PATENTS

In its simplest terms a patent is an agreement between an inventor and the public, represented by the Federal Government, where in return for a full public disclosure of the invention, the inventor is granted the right, for a period of 17 years, to exclude others from making, using, or selling the invention in the United States. It is a limited monopoly designed to encourage a public disclosure of inventions so that after the monopoly expires the public is free to take unrestricted advantage of the invention.

The patent act spells out what can be the subject of a United States Patent and if something sought to be patented falls into one of these categories, it is patentable if it also satisfies the requirements of utility, novelty, and non-obvious. Two of the categories of patentable inventions that are often involved in cases relating to computer programs are processes and machines. For patent purposes a process may be defined as a series of steps devised for the production of a given result. It need not be limited to any particular apparatus. On the other hand, a machine is a distinctive means for accomplishing certain results and unlike a process is limited to a particular apparatus. Although the statute does not specifically set out the subject matter exempted from patentability, the courts have, over the years, determined that certain classes of subject matter are implicitly non-patentable. These include: printed matter, naturally occurring substances, methods of doing business, ideas, scientific principles, mental processes, and mathematical equations.

The kind of protection afforded by a patent is very formidable. For example, someone may be an infringer of a patented invention even though he did not copy from the patent owner's disclosure but actually invented the same thing on his own after the first inventor. Furthermore, the defendant in an infringement suit involving a patent that is declared valid and infringed, may be liable for treble damages, or a reasonable royalty, based on the number of products sold which incorporated the invention. He may have to pay attorneys fees and is subject to an injunction against continuing the infringing acts. However, the statutes regulating the award of patents are very stringent and therefore the process for obtaining a patent is long, and may be relatively costly and complex. It involves careful examination of the inventor's concept by the Patent Office Examiner in light of all applicable prior art that exists at the time the application is filed. As an example of the stringent requirements of the patent laws, if an invention has been offered for sale for more than one year prior to the time the application for a patent is filed in the United States Patent Office, then the invention is barred from ever being patented.

It usually takes at least one year from the date of filing for a patent to issue and more frequently it takes longer, particularly if the examination process involves appeals. No patent protection is afforded by having an application on file in the Patent Office. No one can be liable for infringement of a pending patent applications, liability can only arise after the patent is issued. Therefore, in the case of patents one has to consider the tradeoffs between a relatively high level of protection against the cost, delay, and the stringent requirements for obtaining a patent.

COPYRIGHTS

Although the copyright act owes its existence to the same clause of the United States Constitution as the patent law, the type of protection afforded by copyrights is significantly different. Copyrights give the proprietor the exclusive rights to print, reprint, publish, copy and vend a copyrighted work for a period of his life plus 50 years or 75 years depending on the circumstances of its creation. The basic requirement for a copyright is that the work be original where the word "original" doesn't mean that the work is novel or unique but that it originates with the author. The Constitution limits the copyright to the writings of an author. However, the copyright laws have been applied to a variety of categories of works far broader than we would ordinarily ascribe to the meaning of the term writing. For example, in addition to the usual works which we would consider writings, such as books, periodicals, newspapers and the like, the copyright also protects musical compositions, maps, works of art, photographs, motion pictures, photo plays, and sound recordings. The copyright act provides for several categories of momentary recovery, injunctive relief, and even impoundment and destruction of the infringing work in appropriate circumstances.

One important thing to keep in mind in differentiating between copyrights and patent rights, is that in effect, copyrights only protect the form of expression of a concept, not the concept itself. In other words, if you were to write a book describing an invention, the copyright would give you the exclusive right to make copies of that book. However, anyone reading the book could make use of the invention itself irrespective of the copyright. Thus, ordinarily a copyright cannot be relied upon to adequately protect an invention. However, as we all know in the case of programs, the form of expression takes on some special significance as compared to other ordinary writings and in that case a copyright may

Table 1. Characteristics of Protective Mechanisms

General Considerations	Copyright	Patent	Trade Secrecy
1. National Uniformity	yes	yes	no
2. Protection Effective Upon	creation of work	successful prosecution of application	entrance into contractual relationship
3. Cost of Obtaining Protection	nil	moderate	moderate
4. Term of Protection	life plus 50 years or 75 years	17 years	possibility of both perpetual protection and termination at any time
*5. Cost of Maintaining Protection	nil	nil	significant
*6. Cost of Enforcing Rights Against Violators	moderate	moderate	higher
7. Availability of (a) Statutory Damages (b) Attorney's Fees From Infringers	a. yes b. yes	a. no b. yes	a. no b. no
8. Protection Lost by	gross neglect	unsuccessful litigation	disclosure
Software Considerations, Including Effects of Subcommittee Proposals			
9. Consistency with other copyright areas	yes	no	no
10. Availability of protective mechanism for some programs	yes	yes	yes
*11. Universal Availability of protective mechanism for all programs	yes	no	no
12. "Process" protectable	no	yes	yes
13. Suited to Mass Distribution	yes	yes	no

COMMENTS WITH RESPECT TO STARRED ITEMS IN THE TABLE

Item No.

5. Once copyright or patent is secured, it costs little or nothing to keep it in force; on the other hand, expensive security measures must be taken to avoid losing a trade secret. The cost of this security is, of course, passed on to the user.

6. Copyright and patent infringers in some instances can be persuaded to comply without the institution of a law suit. If litigation is necessary it may be expensive, but in copyright and patent cases attorney's fees may be awarded to successful plaintiffs. At trial the proprieter bears the burden of proving that the trade secret is valid; in patent cases there is a presumption of validity and in copyright actions a registration certificate is prima facie evidence of the copyright's validity. The proof of the validity of a trade secret may be expensive and difficult, as it almost necessarily involves the retention of expert witnesses. Although such witnesses may be needed in copyright and patent, in those cases there will have been at least some compliance with federal law regarding public notice of claimed rights before the lawsuit is initiated. A suite to enforce a trade secret, even though successful, may destroy the secret if it is offered into evidence and becomes part of the public record of the trial.

11. Only those programs which are truly novel and nonobvious may be patented. Trade secrecy is, of course, unavailable when the contents of a program have been disclosed.

afford certain effective protection.

One further distinction compared to patent rights is that a copyright does not protect against others who come up with the same form of expression for their concept. Thus, if someone independently and without copying produces essentially the same end product, that is, the same writing, he will not be an infringer of your copyright and in fact he could obtain a copyright of his own which he could then sell or license to others. Under the patent law, only the first inventor can obtain the monopoly rights afforded by patents, and later inventors, even though they invent independent of any knowledge of the first inventor's efforts, will be infringers.

TRADE SECRET

A trade secret is commonly defined as any formula, pattern, device, or compilation of information, which is used in one's business and which gives one an opportunity to obtain an advantage over competitors who do not know or use it.

When a court is confronted with a trade secret case it has basically two inquiries to make, namely:

1) Whether there really is a secret in the first place, and
2) Whether there exists any duty on the part of the person who learns the secret not to use or disclose it.

Although some cases suggest that the secrecy in a trade secret case must be absolute, that is, the secret must be known only to the owner; these decisions are in the minority. The majority of decisions indicate that absolute secrecy is not essential but only a substantial element of secrecy must exist so that there would be difficulty in others properly acquiring the information. There is no current federal trade secret law, however, many states including California, have adopted trade secret theft statutes. Unlike patents and copyrights there are no formal requirements of trade secret protection; i.e., no forms to fill out and no administrative agencies to deal with. However, in order to be in a position to show that an alleged trade secret was actually a secret, it may be necessary to invest a great deal of money, time, and effort, to prevent its inadvertent disclosure.

Courts often find that trade secret protection is not justified because of a lack of genuine secrecy resulting from laxity on the part of the would-be owner of the trade secret in keeping the subject matter from disclosure. Of course, even the most thorough system of secrecy maintenance cannot insure the continued existence of a trade secret since if others acquire the secret information by proper means and it thereby becomes generally well-known, it is no longer protectable. For example, if through independent efforts of others the information becomes known to them and they make it public, it is no longer protectable. Similarly, if you sell a product which you regard as protected by trade secret law and others who buy it use it to reverse engineer and discover the basic technology upon which the product is based, the secret status of the information is lost. Furthermore, there may be some type of publication or inadvertent disclosure in which the trade secret status of the information is forever lost.

Accordingly, trade secret protection is on the opposite side of the spectrum from patent protection. It's relatively easy to obtain in most cases, since it only depends on actual secrecy and confidential relationships such as those derived either through employment or by contract. However, it is very risky and protection may be lost for a variety of reasons.

PATENT FORMAT AND PROCEDURE

The patent application has three major components, including one or more drawings which describe the invention, and a detailed description of at least one embodiment of the invention which describes the best mode of practicing the invention as contemplated by the inventor. (This description, according to the law, has to be in such full, clear and concise terms as to enable one skilled in the art to make and use the invention.) Finally, the patent must have one or more claims. In each claim the inventor indicates in a single statement what he regards as the essential elements of his invention that differentiate it from all the prior art.

When the patent application is filed in the Patent Office, it is sent to an examiner who has been assigned to the technology to which the invention pertains. He performs a patent search in an effort to determine whether or not the invention satisfies the statutory requirements of being novel and unobvious. In order to satisfy the novelty requirement, it is necessary that nothing identical to the claimed invention have been publically known before the invention by the patent applicant. However, the unobviousness requirement is a much more subjective question and has been the source of much difficulty in both the Patent Office and the courts. Basically, the invention cannot be a mere obvious extension of the existing art to one having ordinary skill in the relevant technology.

If the patent examiner rejects the claims in the patent application, ordinarily the patent attorney prosecuting the patent application either amends the claims to overcome the art cited by the examiner or argues with the examiner that his interpretation of the differences between the invention and the prior art is incorrect and the patent should be issued. If the examiner persists in his rejection of claims beyond the point where the attorney feels an amendment is justified, an appeal may be taken to the Board of Patent Appeals in the United States Patent Office. On the average, approximately one third of the appeals to the Board result in a reversal of the examiner. If the Board affirms the examiner, the patent applicant may then appeal to a higher authority outside the Patent Office. Virtually all appeals are taken to the Court of Customs and Patent Appeals (CCPA) since it is generally felt that this court is the most knowledgeable in patent matters and is more likely to give an independent judgement based upon its own interpretation of the patent laws and the applicant's disclosure and claims.

PATENTS AND COMPUTER SOFTWARE

Up until about 1969 court cases relating to patents and applications involving computer program inventions were more or less categorized as mental step cases; the leading case up until that time being In re Abrahms. Abrahms was commonly interpreted as indicating that mental steps could be included in a process claim but that the novelty of the invention could not depend solely on the mental steps. In 1969 the CCPA decided In re Prater and Wei. The patent application included method and apparatus claims directed to identifying constituent gases in a mixture by a novel solution of equations derived from spectrographic readings. The application disclosed an apparatus for carrying out the invention and also suggested that a digital computer might be used. The problem arose because certain elements of the claim that could be accomplished mentally or with pencil and paper were not necessarily linked with any specific apparatus. The CCPA has first held that steps which could be performed mentally can be included and relied on for patentability if an apparatus such as a digital computer is disclosed in the specification to perform the method. In the 1969 Prater case the court held that method claims reciting purely mental steps are non-statutory, where "purely mental" corresponds to the absence of any express claim limitation for

performing the method step other than mentally or by pencil and paper.

In another 1969 case, In re Bernhardt and Fetter, the CCPA again ruled on a case involving computer programming steps. The invention related to automatically making two dimentional drawings from data defining an object in three dimensions. Novel equations were disclosed and claimed as a computer program to respond to signals defined by the equations. The court ruled the claims to be statutory, finding that the specification of a digital computer in the claim was adequate apparatus to preclude reading on mental steps. In effect the court was holding that one could rely on a mathematical formula for novelty. The claim limited the formulas to use in a stated machine since the effect was not the patenting of the new equation, but only a computer programmed to use the equation in a certain way.

In 1970 the CCPA decided In re Mahoney. The invention related to a method of using framing bits to synchronize a digital bit stream. Although the specification disclosed logic circuits for operating on electrical signals, the claims recited this step using the word "bits." The Patent Office rejection was based upon its interpretation of the word bits as being related to not merely electrical signals but to mental steps as well. The court found the claims reciting operations on bits as being statutory subject matter because the patent applicant showed in his disclosure that he regarded his invention as applying to electrical signals.

In 1971 the CCPA decided the In re Benson case in which the invention related to a method for converting BCD data to binary data. The court found that to be statutory subject matter, although the claims included little or no physical apparatus associated with the method steps. The Patent Office sought and obtained review by the Supreme Court of the United States. Before the Supreme Court had a chance to render its decision in Benson, the CCPA considered the In re McIlroy case in which the rejected claims defined a method for retrieving data from a memory using indirect addressing. The Patent Office had rejected the claims on the premise that only machine implemented methods can be statutory and that the claims of McIlroy didn't require machine implementation. The CCPA reversed holding that the machine implementation vs mental implementation was not a determinative dichotomy in deciding whether a method claim was statutory and held that a process having no practical value other than enhancing the internal operation of a digital computer was statutory.

In November 1972, the U.S. Supreme Court decided Gottschalk vs Benson reversing the decision of the CCPA and holding that the claims to a method for converting from BCD to binary were non-statutory subject matter. Unfortunately, the Supreme Court's decision in the Benson case was ambiguous as evidenced by the many conflicting interpretations of that decision. The major computer hardware manufacturers and their representative associations, who do not want patents granted on programs for their machines, interpret the Benson decision broadly as a proscription on patents for software and software related inventions. Software development firms, on the other hand, advocate patent protection for their "inventions" and interpret the Benson decision narrowly as applying to only the specific facts of that case.

The judges of the United States Court of Customs and Patent Appeals are also split in their interpretations of the Supreme Court decision in the Benson case, but the majority has apparently sided with the software people by interpreting the fundamental rationale of Benson to be merely that a method encompassing all practical use of a mathematical formula and the involved algorithm constitutes non-statutory subject matter.

In a series of software related cases decided after the Benson decision, the CCPA has apparently begun to set guidelines for software related inventions. In In re Johnston, the invention related to an automatic financial record-keeping system including a digital computer claimed as a record keeping machine system. The CCPA reversed the Patent Office's rejection based on the question of patentable subject matter holding that a machine system is within the technological arts and is statutory subject matter and further, that the claims in apparatus form do not encompass a law of nature, a mathematical formula, or an algorithm. The Supreme Court reversed the CCPA deciding that the invention was obvious in view of the prior art, but expressly declined to consider the patentable subject matter question.

In In re Noll, the invention was a raster scan computer graphic system claimed as an apparatus. In reversing the Patent Office, the CCPA decided that the Benson case was limited to method claims and that Noll's claims were patentable subject matter because they were drawn to physical structure and not to an abstract law of nature, a mathematical formula, or an algorithm. It thus appeared that if a computer program-related invention could be claimed as an apparatus or machine system it would be patentable subject matter according to the CCPA. In In re Chatfield, a case decided the same day as the In re Noll case, the claims were in method form. The invention related to a method for dynamically evaluating and re-assigning program priorities in a multi-programmed computer system, however, no program per se was claimed. The CCPA held that since the claims were drawn to a unique method for improving the operating efficiency of a system of machines, they were not drawn to subject matter judicially determined to be non-statutory, i.e., mathematical problem solving, algorithms, or purely mental steps.

The CCPA went on to state:

> "A patent issuing on Chatfield's claimed method would thus preempt neither the mathematical formula nor the algorithms specified in such a patent, unless used in the performance of the entire claim method. Such a patent would thus not be "in practical effect. . .a patent on the algorithm itself". . . the claimed process does not end with solution of a particular equation as in Christensen nor are the appealed claims so "abstract and sweeping" as those in Benson, being limited to the particular operation of a computing machine system as specified in the claims. Thus, the claimed method differs materially and significantly from the invention in either Christensen or Benson. We therefore are not persuaded to discount Chatfield's novel contribution to the useful arts as outside the field of endeavor intended to be encouraged by our patent law."

Following the Supreme Court's Benson decision, the CCPA was asked in In re Christensen to decide whether a method combining known physical steps with a novel equation was patentable subject matter. The invention was a method for determining the porosity of sub-surface formations by gathering data using several known physical steps and then computing the porosity using the data in a novel equation. The CCPA decided that the several physical steps antecedent to solving the equation did not make the invention patentable subject matter.

The Patent Office, which has apparently sided with those who have interpreted Benson broadly against the patenting of software related inventions, has relied extensively on the Benson and Christensen decisions for denying patents for computer program-related inventions. The Noll and Chatfield decisions of the CCPA have, by treating the Benson decision as a narrow one

and by greatly limiting the effect of the Christensen decision, severely limited the grounds of rejection of computer related cases by the Patent Office.

Since the Noll and Chatfield cases, the CCPA has been called upon a number of times to further delineate guidelines on the patentability of computer related inventions. Five computer program-related cases have been decided in the past year since the Noll and Chatfield decisions; they are: In re Deutsch, In re Waldbaum, In re Flook, In re De Castelet, and In re Richman.

The Deutsch invention was a method for controlling and optimizing the operation of a system of multi-unit plants, such as oil refineries at different geographic locations. The Patent Office rejected the application as being non-statutory subject matter basing its decision on its interpretation of the Benson and Christensen decisions. The CCPA reversed, holding that nothing in the methods claimed by Deutsch preempt a mathematical formula or algorithm for any specific computer program. The court indicated that if eventually the patent issues with the claims on appeal, the formulae, algorithms and programs disclosed in Deutsch's specification would be freely available to all and could be used for any purpose other than the operation of a system of plants or their equivalent as spelled out in the appealed claims. The test the CCPA appeared to use was whether or not in consideration of the claimed invention as a whole, taken in light of the specification, the claims reflect any effort to preempt or any resulting preemption of a mathematical formula, an algorithm, or a computer program.

In In re Waldbaum, the invention related to a method for controlling a data processor to determine the relative numbers of zeros and ones in a data word for the specific application of counting the number of busy and idle lines in a telephone system. The CCPA found that the claims in the patent application could be divided into three logical groups, namely: (1) those directed to a method specifically applied to counting busy and idle lines in a telephone system, (2) those directed to methods for controlling the operation of a data processor and (3) those directed to a new use of a stored program data processing apparatus.

The CCPA found that the Benson decision proscribed the allowance of the claims in the second and third groups because they were so abstract and sweeping as to cover both known and unknown uses of the method claim, and that even though the two groups of claims were limited to the operation of data processing apparatus, the algorithm involved was not limited to any practical application other than in connection with such apparatus and therefore a patent on the claims would in effect be a patent on the algorithm itself.

Then the CCPA went on to analyze the first group of claims and appeared to be saying that they would be allowable subject matter when they stated:

> "They would not preempt all uses of the algorithm but would preempt only the use of the algorithm in calculating the number of busy and idle lines in a telephone system."

However, the CCPA still considered these claims unpatentable subject matter although its reasoning is not particularly clear. The court stated:

> "At the same time it must be recognized that a patent on these claims would, in practical effect, be a patent on the algorithm itself — albeit in its limited specific application to calculating the number of busy and idle lines in a telephone system, the situation is analogous to that before this court in In re Christensen where, although the claims were limited to a specific application of technological significance, they were nonetheless directed to a calculation that would have preempted use of the algorithm *in making the calculation.*"

The CCPA went on to indicate that there was a marked contrast between the claims of Waldbaum and the claims of Chatfield which were claims to a method of operating the machines of a computer system more efficiently. It appears that the principal difference relied upon by the CCPA in deciding differently in the two cases is, that the main Chatfield claim did not include an algorithm, while the claims in Waldbaum did include statement equivalents of an algorithm. Both inventions related to data processing systems per se and not to the application of data processing systems to some external control functions, such as, in the Deutsch application.

In In re Flook, the invention related to a process for controlling at least one parameter of a catalytic hydrocarbon conversion process in which an alarm value is periodically adjusted as a function of the history of the actual value of the parameter and the adjustment is accomplished by some type of computer in accordance with a mathematical control equation. Even though the main claim recited the mathematical equation, the CCPA found it to be patentable subjet matter contrasting it with its Christensen decision because unlike the Christensen claims, the Flook claim included recitation of a post solution activity, a step in which the solution of the algorithm or equation was applied to a control system. Thus Flook's claims were unlike those in the Christensen case where the CCPA reasoned that Benson requires that a claim must include a recitation which materially limits the claim to a scope less than merely the act of solving an algorithm.

In two recent decisions, In re De Castelet and In re Richman, the CCPA rendered decisions which further define the distinctions between patentable and unpatentable subject matter for claims that involve mathematical equations.

In In re De Castelet, the claimed invention related to a method of generating curves from data supplied to the computer and in turn using the output to control drafting and milling machines. Although the claims did not recite the specific equation, the Patent Office took the position that an algorithmic process was involved and that this was the sole novel aspect of the invention as claimed. The CCPA held that even though the computer is instructed to transmit electrical signals representing the results of the calculations, this does not constitute the saving type of post-solution activity found in In re Flook. The post-solution activity in this case was merely transmitting the results of the calculation to an apparatus and a patent containing such claims, would in effect, be no more than a patent on the equations themselves.

In In re Richman the invention related to a method of calculating an airborne radar bore site correction angle or velocity component for the aircraft carrying the radar, by utilizing a mathematical formula. The fact situation was similar to that in the Christensen case in that the claim terminated with a mathematical equation with the initial steps in the method used for gathering data for insertion into the equation. The sole difference between the claim in In re Richman and In re Christensen was that the antecedent data gathering steps in the Richman application were considered unobvious, but the CCPA held that a claim to a mathematical expression or its equivalent in words is non-statutory subject matter despite the fact that there are unobvious antecedent data gathering steps.

Thus, the guidelines that the CCPA has apparently set forth seem to be the following:

1. A claim directed wholly to a computer program,

mathematic equation or algorithm per se is not patentable subject matter.

2. A claim presented in apparatus form such as to a machine system will probably be treated as statutory subject matter.
3. If the invention relates to a process involving a computer program which improves the performance of a data processing system and does not involve control of an external non-data processing system, the claim may be statutory if the novelty of the claim does not depend upon the algorithm per se and omits the algorithm in mathematical and statement form.
4. If the invention relates to a process involving a computer program for a data processing system which is claimed in combination with an external system under the control of the computer, it is then acceptable to include the algorithm or mathematical equation in the claim as long as there is some non-trivial post-equation solution activity in the claim and the claim does not end merely with the solution of the algorithm itself.

TRADE SECRETS AND COMPUTER SOFTWARE

There are various tradeoffs to consider in protecting software by means of trade secret laws as compared to protection by the patent law. It is likely, for example, that protection by trade secret extends to more than is likely to ever be extended by the patent laws. Unlike the patent laws which require absolute novelty and unobviousness over the prior art, under trade secret law the extent of the novelty need not be absolute. In other words, others may know of the secret, may have developed it themselves, and yet this may not preclude protection under the trade secret law for the newcomer who has also produced a valuable program by investing his own efforts, or by hiring someone to do so. Another difference is that the trade secret protection may adhere to the program or computer related property, more or less immediately, whereas patent protection requires a significant period of time to obtain and one may not bring suite under the patent laws until the patent issues.

An additional tradeoff between trade secret protection and patent protection is the relative cost. A system for maintaining the secrecy of programs and computer program related inventions has to be established to rely on trade secrecy protection and this may involve substantial investment for security and the like. Patent protection is moderately costly at the time of filing of the application and prosecution of the application, but once the patent issues there is little or no additional related cost since there are no annuities to maintain the patent and no secrecy system to maintain. The requirements for patent protection are extremely stringent and the judicial interpretations of validity of a patent are relatively subjective and for the past ten years or so have appeared to be biased against the patent owner. Thus despite the investment there is always the question of whether or not a particular court will find the patent valid and infringed before it will render any type of judgement for the patent owner. In trade secrets, if the trade secret property owner can show that the invention was indeed kept secret and that the defendant violated an implied or express confidential relationship, so that the defendant has come by the trade secret property in an improper manner, the court will not be subject to a difficult judgement decision as to the merits of the invention itself.

On the other hand, patent protection, which is based on the philosophy that inventors should be rewarded for bringing forth their inventions to the public knowledge, does not rely on secrecy. In fact the patent statutes require that the inventor teach the public in clear, concise and distinct terms how to practice the best mode of the invention contemplated by the inventor. The reward for this disclosure is a 17 year right to exclude everyone else from making, using, or selling the invention, and that includes others who make the same invention on their own without copying from the patent owner. In trade secrecy law, if a newcomer comes across the same invention on his own, by independent engineering effort, the trade secret owner who first invented the same invention cannot stop the second from using it. Furthermore, the trade secret is a relatively volatile property right which can vanish into thin air overnight if the secret inadvertently becomes public knowledge, such as, by means of independent invention by others, inadvertent disclosure by the owner, or independent disclosure by others who are not obligated to the owner of the trade secret to keep it in confidence.

We do know through experience that trade secret protection is readily available for computer programs. In a leading trade secret theft case in California, Ward vs Superior Court, a service bureau employee was charged with theft of a program from a competitor's computer by unlawful access through communication lines. The victim of the theft was a time sharing service bureau operating a computer in the memory of which resided the program which was the object of the alleged theft. Access to the system was available to the service bureau's subscribers by dialing the bureau's unlisted phone number and inputting both the customer's site code and one of that customer's billing numbers. An employee of a competitor service bureau allegedly obtained the necessary numbers, accessed the system by telephone and extracted the program in question by having it printed out at his own location. The California trade secret theft statute prescribes guilt for one who, among other things, steals, takes away or carries away any article representing a trade secret or having unlawfully obtained access to the article without authority makes or causes to be made a copy of any article representing a trade secret. The defendant pleaded guilty to theft of trade secrets and was sentenced to a fine of five thousand dollars and three years probation. In a corresponding civil action, the same set of facts gave rise to a judgement against the programmer's employer for $250,000 plus compensatory damages and $50,000 punitive damages. The stolen software was valued by its owner at somewhere between $10,000 and $20,000.

Trade secret protection was given to computer programs in Hancock vs State. Hancock possessed certain computer programs of his employer. He was caught trying to negotiate with a client of his employer for the sale of 59 of the programs. The court had to look to the Texas criminal statute for a definition of property but concluded that computer programs were property within the meaning of the statute and found Hancock guilty of violating the statute.

Trade secret protection and patent protection are not entirely incompatible. During the period after the patent application is filed, but before the Patent Office issues the corresponding patent, the information disclosed in the application remains in absolute secrecy in the Patent Office. This period is usually one to two years and sometimes longer. During this period, therefore, the invention may be treated as a trade secret in contractual relationships and in employment relationships.

COPYRIGHTS AND COMPUTER PROGRAMS

Although there have been no court tests of whether or not computer programs are protectable under the current copyright law, the Copyright Office has maintained a policy of permitting registration of computer programs for copyright protection. Under the current policy

of the Copyright Office, computer programs will be registered if they meet the following requirements:

1. The elements of assembling, selecting, arranging, editing, and literary expression that went into the compilation of the program are sufficient to constitute original authorship.
2. The program has been published with the required copyright notice that is, "copies (i.e. reproductions of the program in a form perceptible or capable of being made perceptible to the human eye) bearing the notice have been distributed or made available to the public."
3. Copies deposited for registration consist of two complete copies of the program in the form as first published. If the first publication was in a form (such as machine readable tape) that cannot be perceived visually or read by humans, a visually perceptible reproduction or description such as a print-out of the program must also be deposited.
4. The Applicant also submits a brief explanation of the way in which the program was first made available to the public, and the form in which the copies were published. This explanation is not essential in every case, but will generally facilitate examination of the claim for copyright.

In November 1976 President Ford signed into law a new copyright act which took effect on January 1, 1978. This is the first major revision of the copyright law since 1909. One of the purposes of the new act is to draw within the protection of the copyright laws new technological advances that could not possibly have been contemplated by Congress at the time it passed the 1909 law. Congress has established a National Commission on new technological uses of copyrighted works, which among other things has the responsibility for studying the manner in which computer programs should be dealt with by the copyright law. This Commission has established a software subcommittee to prepare a preliminary report on the protection of software by copyrights.

The Commission's final report on the protection of software, as well as other new technological possibilities for a copyright protection will be submitted to Congress some time during 1978 and it is anticipated that the new copyright act will then be modified in accordance with the Commission's recommendation regarding the protection of computer programs. In the interim, Congress included a section in the new act which in effect provides that the owner of a copyright in a work used in conjunction with automatic systems capable of storing, processing, receiving, or transferring information or in conjunctin with any similar device, machine or process, has no greater or lesser rights with respect to such works than those afforded under the 1909 law. In other words, Congress decided to leave the copyright law, with respect to computer programs, in limbo until it can make modifications in accordance with the report of the National Commission.

The Software Subcommittee has concluded that the new act should include specific provisions calling for copyright protection of computer programs. It bases this conclusion on a comparison of the protection available under patent and trade secret laws and what would be available under the copyright law. Insofar as the patent laws are concerned, its preference for copyright protection is based principally on the premise that only software meeting the rigid standards of novelty and nonobviousness required by the patent law could be patented, therefore, programs not meeting the stringent requirements would go unprotected. With regard to trade secret protection the Software Committee found its deficiencies to be:

1. Its hostility to the free exchange of ideas.
2. Its inappropriateness with respect to general-purpose programs having a potentially large market, since, by its very nature a trade secret is something that its owner cannot distribute widely since the distribution of each copy of the item makes it increasingly likely that a breach in security and loss of the secret will occur.
3. Trade secrecy protection generally becomes unenforceable through the disclosure of the confidential information to anyone outside the scope of the agreement whether the disclosure is intentional, inadvertent, or caused by the disclosee of the information.
4. Each transaction involving a secret program requires substantial expenditures to maintain its security, thereby, adding considerably to the cost of the product.
5. Each state is free to develop or not develop the trade secrecy doctrine as it sees fit.

On the other hand, the committee finds that copyright protection is provided by relatively simple uniform Federal laws. Transaction costs associated with copyrights are small compared to patents and trade secrets. Protection is difficult to lose under the new act and copyright is designed to protect the proprietor of the information while still promoting the dissemination and thus development of the art.

. . .if more explicit protection under copyright law were available . . .the result would be. . .an increase in the dissemination of computer program information to the industry as a whole . . .

There are those who argue that copyright protection for computer programs is unnecessary because the software industry is already burgeoning in a market where the availability of legal protection is unclear and that infringements of programs are difficult to detect. The subcommittee on software argues with respect to the first contention that it is not true that the software explosion has occurred in the absence of copyright. Rather, it argues that the software explosion has occurred in a world in which an amorphous mix of trade secrecy, copyright, contractual, and perhaps patent protection, has been available and has been employed by various proprietors. A large number of general-purpose programs available for sale or lease bear copyright notices which have permitted copyright holders to achieve settlements with suspected infringers without the necessity of instituting a suit. For example, all the program products of IBM and Digital Equipment Corporation bear copyright notices. Furthermore, if more explicit protection under copyright law were available, the subcommittee believes that the result would be a beneficial change in the status quo that would decrease reliance on trade secrecy and increase the dissemination of computer program information to the industry as a whole while protecting the proprietors of such information. With respect to the second contention, the difficulty of detecting infringers, the subcommittee

believes that the asserted difficulty concerning enforcement cannot militate against the law's existence, it merely suggests that more efficient means of enforcement must be found.

Thus, the committee proposes to review the current law to make it explicit that the inputting of a program by anyone other than a rightful possessor is an infringement. It has also proposed that the law include a provision designed to permit a user of a rightfully acquired program to prepare a copy for storage as insurance against loss in the event of destruction of the program. They have defined wrongful possession of a program to include, but not to be limited to the following:

1. Possession of a "pirate" copy.
2. Possession of a stolen but "non-pirate" copy.
3. Retention of any copy after the expiration of a period of rightful possession, or
4. Retention of any copy after transferring all rights in a program to another.

In addition, the law would provide that in the absence of explicit authorization from the copyright owner, the preparation by the rightful user of multiple copies whether for internal distribution or transmission to others would be an infringement. It would also provide that conversion from one computer language to another, such as from COBOL to FORTRAN, would remain the exclusive right of the copyright owner. Of course, owners of copyrights in programs in which copies are sold could no way restrain the further sale of such copies but their buyers could not make and re-sell or retain additional copies without infringing the copyright.

With respect to copyright notice, the subcommittee has recommended that copyright notice should be required in all formats in which a program is marketed. On programs capable of being read by the unaided eye, such notice should appear prior to the list of instructions that comprise the program. Those programs which can be read only with the aid of a machine or device should contain a copyright notice in the medium of fixation, such that the contents of the program cannot be listed without reproducing the notice in the position just described. It also recommends that containers in which copies of machine-readable programs are sold, leased, or transported, should bear plain notices, and so should devices such as reels upon which the magnetic tape is wound and semiconductor chips in which programs are stored.

A WAY TO PROTECT COMPUTER PROGRAMS AT THE PRESENT TIME

Despite the lack of total clarity with respect to protection of computer programs by copyright or patent, it is my opinion that proprietors of computer software should take advantage of all three possible forms of protection as appropriate for their particular end product. Those programs and inventions related to computer programs, which constitute major advances in the art and have significant value which would extend for a period of at least five years, should be given patent protection, particularly if such program related inventions include some novel physical aspect that can be related to the program in an overall system combination.

Whether or not patent protection for programs and computer program related inventions is sought, contractual relationships specifying trade secret protection for computer programs should be relied upon. Of course, in the case of programs and program related inventions for which patent protection is sought, trade secret protection can be relied upon only until the patent issues and renders the information public.

Programs should all bear copyright notices in accordance with the recommendations of the software committee of the National Commission. Care should be taken, however, in those cases in which works bearing copyright notices are protected by trade secrecy agreements to make it explicit that despite the copyright notices there should be no presumption of publication which is or course inimical to trade secrecy protection. And lastly, proprietors of programs and program related inventions should stay current, at least through their patent attorneys, with respect to the latest case law regarding patent protection, trade secrecy protection and new regulations to be promulgated by the Copyright Office under the new copyright act for rules regarding registration and deposit of computer programs.

Most patent attorneys in private practice specialize exclusively in intellectual property matters including, patents, copyrights, trade secrets and trademarks. To use the title, Patent Attorney, the attorney must be registered to practice before the United States Patent and Trademark Office which requires a technical background and the passing of an examination relating to patent laws and the rules of practice in the Patent Office. The intent of the system is that Patent Attorneys should be qualified to handle both the technical aspects and legal aspects of patent matters.

A patent attorney should be consulted whenever intellectual property rights are: (1) to be defined (such as, whether or not a program is protectable and by what means); (2) to be created (such as, by obtaining a patent); (3) to be asserted (such as, by suing for infringement); (4) to be transferred (such as, by assignment or license); (5) to be challenged (such as, by a declaratory judgement action to hold an issued patent invalid); (6) to be effected by another transaction (such as, by a sale of an existing business, by the establishment of a new business, or by an employment agreement).

Unlike lawyers who, for example, specialize in personal injury cases, criminal matters or marriage dissolutions, patent attorneys should be consulted as a preventative measure whenever intellectual property may be involved. Waiting is often prejudicial to intellectual property rights which may be irretrievably lost because of a failure to take the appropriate action at the appropriate time. For example, a businessman who decides to test the acceptance of his product in the marketplace for a significant period of time before he seeks to protect the invention embodied therein, risks being barred from obtaining a patent irrespective of the merits of the invention. Thus, a patent attorney should be consulted as soon as possible.

In the case of computer program-related inventions, the patent attorney has the same principal task as with any invention, namely, to determine whether or not the invention is protectable and by what means. However, in the case of computer programs he has the additional task of determining whether or not the invention can be patented under the current guidelines of the Court of Customs and Patent Appeals and also to determine whether in view of the potential additional complexity in prosecuting a program-related patent application the business considerations merit the possible increased cost of obtaining a patent. Furthermore, the patent attorney who regularly handles matters involving inventive programs and program-related inventions has the added responsibility of remaining current as to the laws and considerations relative to computer programs under the various Federal and State laws and judicial decisions relating to protection of that type of intellectual property.

Although this article should not be relied upon as legal advice for any specific situation (since each problem requires the individual and first-hand attention of an attorney), the author will be pleased to respond to comments and inquiries relating to this article. Letters should be sent to: Leonard Tachner, Attorney-at-Law, 2192 Dupone Drive, Suite 210, Irvine, CA 92715. □

Using the Heathkit H8 System in Hobby, Home and Business Applications

By Richard S. Arnold

INTRODUCTION

This article will present an analysis of the merits of investing in the Heathkit H8 computer system. The focus here is on the strengths and weaknesses of the system in hobby, home and business applications.

THRESHOLD CONSIDERATIONS

The word "investing" is a deliberate choice, and doesn't just mean "buying." It's chosen to suggest that the decision to buy a given microcomputer, and indeed whether or not to buy *any* microcomputer, should be approached in a deliberate, rational manner. This is just as true whether you're a hobbyist, a professional or businessman, or simply someone who has to have the latest computer gadget before anyone else on the block.

At first blush, there would seem to be an overwhelming number of factors to consider in making this decision. The newcomer to microcomputers has a hard time sorting out the significance of the various features offered by different systems, even after he's finally figured out what all (or most of them) mean. All too often, the result is that the choice of a particular system is made primarily on a subjective basis. We have been conditioned to do this by the methods used to market other consumer products, from cars to television sets. However, an objective decision isn't all that hard to make — after all, that's what a computer itself does, after it's taught to do so by the programmer.

Really only two steps are involved here. The second step — the one usually focused on first — is a determination of what you want the system itself to do. The first step, however, is at least as important; you should begin by looking at *yourself,* and only then should you look at the system.

WHAT YOU'RE INVESTING

In deciding what you *can* invest, and what you *want* to invest, you might as well begin with your pocketbook. Certainly cost is a major factor; frequently it is controlling. Remember, too, that microcomputers are in their infancy, and that as new uses are developed, new hardware and software will likely be necessary. Computers are like cameras, stereos and ham rigs in this regard; what you start with is in all probability not going to be everything you'll ever want or can convince yourself that you need!

More than money is involved here, though. Take a hard look at the time you're willing (and able) to invest in your system. If it's a kit, you'll have to build it, and whether or not it's a kit you'll have to debug it. Even if it's ready to run as soon as it's plugged into the wall socket, you (or someone) will have to operate it.

Take an even harder look at your skills and experience. The quality and level of detail of kit assembly instructions varies widely in this field; the same is true of operating instructions and system documentation. The less skill and experience you have in assembling, debugging and operating a computer system, the more important becomes the quality of the system's instructions and documentation. The ultimate variables here are your time and your level of frustration (or, to be more positive, your sense of accomplishment).

The money, time, skill and experience you are willing and able to invest will vary with what you want the system to do. If it's destined to be used in a small business, operated by one or more employees and installed and serviced by experts, these factors will be significantly different than if it's to be used by you (and perhaps your family) at home. The "first step" — looking at your personal investment, in the overall sense — therefore cannot be totally divorced from the second step of looking at why you need (or want) the system. Nevertheless, it's important not to lose sight of it.

WHY YOU'RE ACQUIRING THE SYSTEM

Once you've analyzed what you are willing and able to invest in the system, you should take an equally careful look at why you're going to make that investment. There may be a particular function or set of functions you want the system to perform, such as word processing and accounting in a small business. Instead, you may simply want to learn, through hands-on experience, more about computers.

A great deal has been written about the multitude of uses of microcomputers, and if you've reached the point where you're considering which system to invest in, you probably have already read about most of them. The important thing here is to recognize that different systems can serve different functions with differing amounts of effort (and expense) on your part.

Develop a list, in order of relative importance, of the things you want to realize from your investment. In doing so, try and forecast what you may want to do with the system in the future (even though some of these uses may not seem too important now). Computers can become addictive — once you see how easy they can make one area of your life, you may well decide to use them in another!

If your primary purpose is self-education, remember that building a kit (at least one with detailed assembly manuals) will not, by itself, teach you much more than how to solder. It will, however, teach you that very well! The real education will come in applying the system once you build it, and in debugging the system if you don't build it correctly.

If your primary purpose is business-oriented, the system should be one with reliable support. This is most likely to occur where the system is in fairly widespread use and is from an established manufacturer. The compatibility with various peripherals is also important here, so that the system can be tailored to meet your specific needs.

If your primary purpose is for use in the home, sim-

plicity of operation becomes important. It's unrealistic to expect your family to grow to love your computer like you do if a bootstrap monitor has to be toggled in in binary, and BASIC loaded at 100 baud via paper tape, before the home menu planner, math drill, or checkbook balancing program can be entered and run. If you plan on running a lot of video games, then systems with internal video boards and external video monitors (instead of separate stand-alone CRT terminals) are, at the current level of technology, much more useful.

Again, in matching your perceived purposes with the systems in which you're willing and able to invest, be sure and consider what you may later decide you want to do. I chose the H8 because it fit my educational and home-use purposes. It fills these roles very well, and I'm pleased with my decision. But now I'm looking at other uses, and if those become important enough to me I may wind up wishing I had some other system instead. You can't completely anticipate or solve this problem, at least without unlimited time, experience, and money, since no single system can be all things to all people. However, you can and should anticipate it.

Having gone through the decision process involved in choosing a microcomputer system, let's turn to an analysis of the strengths and weaknesses of the H8 in hobby, home and business applications.

HOBBYIST/SELF-EDUCATIONAL APPLICATIONS

Building a Heathkit, thanks to the excellent assembly manuals, is relatively easy and straightforward. However, assemblying a Heathkit will not, by itself, teach you much more than basic electronic construction

skills. The real educational potential is realized in applying the system once you build it, and in debugging the system if you don't build it correctly. Since no one would intentionally set out to learn debugging in this manner, let's focus instead on what can be gained in applying the system.

The H8 comes complete with all the hardware and software needed to teach yourself programming in assembly language or in BASIC. The H8's excellent front panel monitor, and its console debugger software, make it easy to work with registers, I/O ports, and memory in machine language. Thanks to the octal display format, you can watch — and understand — what's happening while stepping through a program.

The operation manuals accompanying the H8 system are superb. They contain extensive descriptions of the system and its operation, both from theoretical and practical perspectives. The software reference manual, while not designed to be a course in programming, does a superb job of explaining the features and utilization of each software package.

The H8 system is superbly designed for acquiring "hands-on" experience and knowledge. If your primary purpose in acquiring a microcomputer is self-education and hobbyist applications, I believe that the H8 has to be viewed as the best system available today.

HOME APPLICATIONS

A microcomputer system can be used in the home for recreational and/or practical applications. The H8 can function quite well in this environment, but you should take a careful look at the specific uses you have in mind.

Computer games can be fun; they also can be educational. At a minimum, they can provide a rationalization for the time and money you've sunk into that mysterious black box. Beyond that, they also help to remove some of the mystique currently surrounding computers. My five-year-old loves my H8; when she's exposed to computers in school and later in life, they'll be as familiar a tool to her as the pocket calculator is to adults today. Since her generation, if not mine, will have no choice but to deal with computers, the sooner she becomes familiar with them the better.

The H8 system is well suited to the kinds of "games" my daughter now uses it for. I've written a program in BASIC to teach her elementary math, complete with positive feedback (visual and audial) for each correct answer and a display of a running score of how well she's doing. I am also using the "hangman" game software available from Heath to increase her vocabulary. This software allows you to create your own list of words to be randomly chosen by the program, which makes it ideal for this purpose.

As to purely recreational games, the H8 is somewhat limited by its use of a separate CRT terminal rather than an internal video board. No D/A converter is available for the H8 either, at least at the present time. Accordingly, interactive graphics games cannot be played on the H8. In this area, such systems as the APPLE II and S100 computers with graphics and D/A boards are currently the only way to go.

More practical uses, such as checkbook balancing, menu planning, income tax preparation and personal accounts payable programs, can easily be implemented on the H8. Using Heathkit BASIC, you can write such programs yourself or adapt ones written by others. However, because all Heath software uses the H8's ROM monitor subroutines, applications software available on tape for other systems will not run on the H8. At this writing, no such prepackaged tapes are available for the H8.

The same is true for such applications as controlling lights, sprinkler systems, air conditioning and heating systems, etc. Hardware and software for S100 systems

in these areas are now on the market, but none is yet available for the H8.

You can, of course, develop your own hardware and software for any of these applications. Additionally, given the likely size of the market of H8 owners, it is reasonable to expect that both Heath and others will soon make the necessary products available.

The H8 is somewhat less expensive than most of the comparable microcomputers on the market today. It is very easy to operate, and attractive in appearance. These features are important in the home environment, particularly if the entire family is to use the system.

In its current state of development, the H8 is probably not the best system available if your primary purpose is home use. However, subject to the limitations discussed above, it functions well in this role and I would have no hestitation in recommending it.

SMALL BUSINESS APPLICATIONS

Here, further development is needed before the H8 can be fully utilized in many applications.

The H8's text editor software operates only in either upper or lower case. The H9 video terminal operates in upper case only, and its display is of only 12 80-character lines. There is room on the H9 RAM board for another 1K of memory, which indicates that Heath is clearly planning to expand the display to 24x80 in the future. That expansion, coupled with lower case capability, would make the H9 much more attractive in a business application. Of course, there is no reason to necessarily use the H9 terminal with the H8; a number of U/L, 24x80 terminals are now available and can readily be interfaced to the H8 computer. Even then, however, no proprietary word processing system is currently available for the H8.

No prepackaged programs are yet available for using the H8. . . A floppy disk is also necessary here . . .Heath's Extended BASIC should have data file capabilities by the time this article is in print, which makes such applications feasible.

No floppy disk system is yet available from Heath, although one is coming in June. One floppy disk is currently available for the H8 from a secondary source supplier, together with a Z80 processor board and software which should allow word processing. However, the combined cost of that approach may well exceed that of comparable S100 systems now on the market.

Accounts receivable and payroll applications face a similar situation as word processing. No prepackaged programs are yet available for using the H8 in these applications, so you'll have to write your own for now. A floppy disk is also necessary here, at least for all except the smallest businesses. Heath's Extended BASIC should have data file capabilities by the time this article is in print, which makes such applications feasible.

The H8 power supply currently can support only 32K of RAM. This is probably the minimum practicable amount of memory needed for a business-oriented microcomputer. However, because the H8's monitor is in ROM, and Heath's BASIC is fairly memory-efficient, 32K of RAM in an H8 may give you somewhat more capability than in other systems.

A microcomputer used in an office is always subject to the problem of controlling access. Put another way, the assumption has to be that the employee with the least amount of intelligence and training will be the one who is most attracted to the computer and the one who is most likely to press the maximum number of buttons! Turnkey front panels offer an obvious advantage here. Once an H8 program is running, it can't be destroyed without pressing two buttons at once, but that's clearly a possibility. Additionally, because software other than BASIC applications programs currently must be loaded and executed through the front panel controls, the H8 operator has to have access to the computer itself and not just the video terminal. For these reasons, if an H8 is used in a business environment, careful consideration will have to be given to its physical location and to the problem of controlling access to the front panel.

The level of support provided for the H8, at least in the service area, is one of the best in the industry. However, no service contracts are available from Heath, and since the system is available only in kit form you would have to stock your own supply of replacement boards to avoid the possibility of the system being down for at least a few days when trouble developed. On the other hand, if you've built the system yourself you may be able to service it yourself — at least if you can take the time away from your business.

One business application where the H8 can be eminently useful is in developing BASIC programs to be run on time-sharing systems. Apart from the possible incompatibility of certain Benton Harbor BASIC statements, once that BASIC includes data file handling commands (which should be by now) it can perform this role very well. I use my H8 in this application, developing programs for income and estate tax analysis that can then be run on my firm's time-sharing system. Anyone who has seen the bills for the time spent in writing and debugging programs while using time-sharing can appreciate how quickly the H8 can pay for itself here!

The H8 is a sturdy, reliable system which compares very favorably in cost with other microcomputers. Depending upon the nature of your intended business applications, the H8's current level of software and hardware sophistication may or may not make it your best choice. However, once the Heath floppy disk becomes available, we can expect to see a rapid growth in the availability of business-oriented H8 software. That development, coupled with a 24x80 U/L modification for the H9, should make the H8 system a nearly ideal microcomputer for small businesses.

SUMMARY

At its current level of development and support, the H8 is probably best suited for hobbyist and educational purposes. Some applications in the home are less readily achieved, but the H8 is certainly attractive here as well. Many business applications will probably have to await more development of hardware and software, but once that has occurred the H8 should be an excellent choice in this area also.

If you're like most people who are interested in microcomputers, your intended applications probably cut across all three of these areas. This makes it all the more important, when considering the H8 or any other microcomputer, to go through the analysis described above to best match your investment to your purposes. □

DATELINE . . . BASE 2

BASE2 is pleased to offer the following products to the S-100 market at the indstury's lowest prices:

8K Static Memory Board

This 8K board is available in two versions. The 8KS-B operates at 450ns for use with 8080 and 8080A microprocessor systems and Z-80 systems operating at 2MHz. The 8KS-Z operates at 250ns and is suitable for use with Z-80 systems operating at 4MHz. Both kits feature factory fresh 2102's (low power on 8KS-B) and include sockets for all IC's. Support logic is low power Schottky to minimize power consumption. Address and data lines are fully buffered and 4K bank addressing is DIP switch selectable. Memory Protect/Unprotect, selectable wait states and battery backup are also designed into the board. Circuit boards are solder masked and silk-screened for ease of construction. These kits are the best memory value on the market! Available from stock . . .

8KS-B $125
8KS-Z $145

Z-80 CPU Board

Our Z-80 card is also offered in two speed ranges. The CPZ-1 operates at 2MHz and the CPZ-2 operates at 4MHz. These cards offer the maximum in versatility at unbelievably low cost. A socket is included on the board for a 2708 EPROM which is addressable to any 4K boundary above 32K. The power-on jump feature can be selected to address any 4K boundary above 32K or the on-board 2708. An On-board run-stop flip-flop and optional generation of Memory Write allows the board to run with or without a front panel. The board can be selected to run in either the 8080 mode, to take advantage of existing software, or in the Z-80 mode for maximum efficiency. For use in existing systems, a wait state may be added to the M1 cycle, Memory request cycle, on-board ROM cycle, input cycle and output cycle. DMA grant tri-states all signals from the processor board. All this and more on top quality PC boards, fully socketed with fresh IC's.

CPZ-1 $110
CPZ-2 $125

S-100 for Digital Group Systems

This kit offers, at long last, the ability to take advantage of S-100 products within your existing Digital Group mainframe. Once installed, up to four S-100 boards can be used in addition to the existing boards in the D.G. system. The system includes an "intelligent" mother board, ribbon cables to link existing D.G. CPU to the DGS-100 board and a power wiring harness. The DGS-100 is designed to fit in the 5¾" x 12" empty area in the standard D.G. cabinet. It may seem expensive but there's a lot here! End your frustration!

DGS-100 $295

16K Static Memory Board

Base 2 can now offer the same price/performance in a 16K static RAM as in its popular 8K RAM. This kit includes 8K bank addressing with 4K boundary address setting on DIP switches. This low power unit provides on-board bank selection for unlimited expansion . . . No MUX board required. Using highest quality boards and components we expect this kit to be one of the most popular units on the market. Available in two speed ranges, the 16KS-B operates at 450ns while the 16KS-Z operates at 250ns.

16KS-B $285
16KS-Z $325

Send for more details on these products. Get on our mailing list for information on more soon to be announced products at factory-direct prices from BASE2. Why pay more when you can get the best at these prices???

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CIRCLE INQUIRY NO. 85

NEW PRODUCTS

RotaScan Card File

The RotaScan card file's circular concept gives large filing capacity in minimum floor space, reduces card retrieval and replacement time and allows access by several people.

Each tier has fixed metal dividers which may be used for primary indexing. An adjustable backstop enables the file to be adapted for a wide variety of card sizes and microfiche.

RotaScan Card Files are available with from one to eight tiers. Additional tiers can be fitted as filing increases. Units can be housed in a circular security cabinet or mounted on casters if required.

For further information contact RotaScan Retrieval Systems, Inc., 270 Greenwich Ave., Greenwich, CT 06830.

CIRCLE INQUIRY NO. 113

Business Software

Structured Systems Group has announced its Business Systems Series, a growing line of quality business programs. Designed to run on the 8080 or Z-80 CPU and the CP/M™ operating system, all software comes fully documented, field-tested and human-engineered for ease in operation. The following products are currently available and shipped from stock.

General Ledger. A comprehensive GL system designed for professional accountants and small businesses. Quickly set up any custom chart of accounts to handle single or multiple departments. Interactive verify and customize data, formats, and heatings. It is exhaustively documented and computer knowledge is not required. Written in CBASIC, the GL system costs $995.

The Name and Address (NAD) System maintains files and allows selection on all fields for printing labels, reports, or new files. NAD is thoroughly documented and written in CBASIC, for $79.

QSORT. A fast and efficient, easy to use, full disk sort/merge. Its automatic operation, multiple sort keys, and complete backup provide power and flexibility. In 8080 code, $95.

CBASIC. An advanced, comprehensive, commercially oriented compiler/interpreter including full disk access, PRINT USING, 14 digits of precision, and much more. With 85 page manual, $99.95.

Future products will include an accounts receivable system and other financial packages. For more information contact Structured Systems Group, Inc., 5615 Kales Ave., Oakland, CA 94618, (415) 547-1567.

CIRCLE INQUIRY NO. 111

Microbench™ Software

Microbench software is a family of computer programs for microprocessor application program development. These programs operate in conjunction with PDP-11 and LSI-11 computers to provide an economical program development capability for popular microprocessors.

Featured in Microbench software are relocating assemblers and linking loaders for the Intel 8080/8085, Zilog Z-80, Motorola 6800 and equivalent microprocessors. Coded in Macro-11 for high throughput, these assemblers and loaders operate on PDP-11 and LSI-11 computers under the RT-11 operating system in 16K words of memory.

For additional details and pricing information contact Virtual Systems, Inc., 1500 Newell Ave., #406, Walnut Creek, CA 94596, (415) 935-4944.

CIRCLE INQUIRY NO. 115

Put Your PET on the Bus (488 that is!)

The Pickles & Trout PET-488 cable assembly make your PET computer plug compatible with any IEEE-488 device. Think of it! The inexpensive PET Computer can become the controller for a wide variety of electronic test equipment and computer peripherals.

You can use your PET as the basis for an automated testing system, or you can take advantage of the numerous peripheral devices (more appear every month) that can talk to the IEE-488 bus.

The PET-488 cable assembly plugs directly into the edge connector on the back of the PET Computer and has a completely 488 compatible connector on the other end. The cable itself meets all IEEE-488 specs for shielding and cross-talk and is 18 inches (.45m) long.

Price of the PET-488 cable assembly is $30 (California residents please add 6% sales tax) with prepaid orders postpaid in the 48 contiguous U.S. Shipment is scheduled to begin on May 1, 1978. For more information contact Pickles & Trout, P.O. Box 1206, Goleta, CA 93017.

CIRCLE INQUIRY NO. 152

Free Directory Listing Offered

Computer businesses that want to be identified with small computers for the home business or the hobby computer market will be given a free listing in *The Home Computer Guide.* The guide will be a trade directory of manufacturers, distributors, retailers, consultants, clubs, publishers and suppliers; with some informatin as to line handled, specialties, etc.

There is no cost or obligation of any kind to obtain a listing. Advertising will be available, but is not required for a listing. (A free copy of the guide will be given to all advertisers).

A special feature of the guide will include a trade survey of projected sales of home computers. All companies requesting a listing will receive a brief questionnaire asking their opinion as to the sales potential of computers for consumers. The questionnaire will be included with the directory listing form. Other features will include listings of firms by zip codes and by product or service categories.

To receive a detailed listing form send your business card to *The Home Computer Guide*, J & M Assocites, Box 8118, Kansas City, MP 64112.

CIRCLE INQUIRY NO. 154

Tape Drive

The SYS I is a fast, inexpensive, high capacity mass storage for microcomputers. The tape drive subsystem records bi-phase Manchester code at 1600 bits per inch on ANSI specified data cassettes with a transfer rate of 2000 characters per second at 10 IPS.

Rewind time is less than 30 seconds at over 120 IPS. Search can be accomplished at over 120 IPS by counting the inter-block gaps, getting to any record in an average time of less than 15 seconds.

One to four drives may be connected to the computer through the interface board. No power is taken from the computer bus except what is necessary to run the simple synchronous serial interface board.

All units are assembled, tested and guaranteed. The single drive is $595, the dual drive is $969, and the S-100 interface board is $168. Delivery is six weeks ARO. For more information contact General Micro-Systems, 12369 W. Alabama Pl., Lakewood, CO 80228, Bob Smith.

CIRCLE INQUIRY NO. 147

Monolithic Memories to Second Source Multiplier Circuit

Monolithic Memories, Inc., has announced its plans to produce a bipolar 16-by-16 multiplier circuit that will be function- and pin-compatible with TRW's 16-by-16 multiplier — the MPY-16.

Through an informal second-source arrangement, TRW has granted an access to certain documentation on the MPY-16, in return for which, MMI will develop and actively market the MPY-16 by 1979.

The MPY-16 chip will be available from MMI in both commercial and military temperature ranges and in both 64-pin flatpack and 64-pin dual-in-line packages.

For more information contact Monolithic Memories, Inc., 1165 E. Arques Ave., Sunnyvale, CA 94086, (408) 739-3535, ext. 268, Shlomo Waser.

CIRCLE INQUIRY NO. 149

Shock Detector

To detect potentially damaging shocks to disk packs in the computer room, the Shockwatch detects shocks (caused by improper

disk insertion, storage or shiping) that can throw delicate computer mechanisms off-kilter (data loss, head crashes, job reruns and downtime). The adhesive-mounted Telex Shockwatch is designed to prevent operators from using the damaged disk.

A shock of pre-calibrated G-force breaks the Shockwatch's diamond drilled glass capillary, and it turns bright crimson red. The operator instantly is aware of the disturbance.

Telex Shockwatches come in different sensitivity ranges (based on G-force sensitivity) to fit all industrial needs. For information contact Telex Marketing Co., 6464 Sunset Blvd., Los Angeles, CA 90028, Ron Carboy.

CIRCLE INQUIRY NO. 153

Video Checkers on Cassette

Video Checkers is recorded in the Tarbell format and programmed in MITS BASIC (3.1). Checkerboard graphics are produced on the CRT when used with the PolyMorphic Video Interface and 64-character option.

Two versions of the program on one 60-minute cassette play a challenging game which conforms to International Rules. The first version requires a total of 16K of m emory, inclusive of 8K BASIC. The second version is more graphic and requires an additional 4K.

Compu-Quote promises players who test their wits against the computer will win this game a rewarding number of times. Included with Video Checkers is a 9-page instruction book.

Video Checkers and manual may be ordered for $10 from Compu-Quote, 6914 Berquist Ave., Canoga Park, CA 91307.

CIRCLE INQUIRY NO. 157

Parker Brothers Introduces Merlin: A Bit of Electronic Wizardry!

A game so sophisticated it has a voice, a language and an inteligence all its own! That's Merlin, new from Parker Brothers.

Merlin, Parker's latest bit of electronic wizardry, offers a library of six computer games—games of chance, strategy, memory, logic and skill. What's more, Merlin keeps score, congratulates you when you win, gives you the raspberry when you lose.

Merlin's powerful memory contains a library of six games: Tic Tac Toe, the timeless strategy game with universal appeal; Echo: You must repeat a random sequence of musical notes and lights played to you by Merlin; Blackjack 13 is a computerized version of the classic card game in which the object is to acquire the higher hand of 13 or less; Mindbender: Discover, through a process of deduction, the ex-

act order of a random sequence of unknown numbers; Magic Square: Form a square of 8 lights by deciphering Merlin's code; Music Machine gives you the opportunity to compose music. Merlin is tough to beat for fun, tough to beat for challenge, and tough to beat as an electronic game.

For more information contact Parker Brothers, 50 Dunham Rd., Beverly, MA 01915.

CIRCLE INQUIRY NO. 110

LP-316 Light Pen

The LP-316 features the exclusive "Touch Sense"™ activation. The operator simply touches the tip of the pen with his index finger each time a "hit" is desired. A finder beam (to locate the target), increased sensitivity, and the complex optical system of the LP-316 will allow operators to use this light pen where there is a problem with a large or different focal distance and/or paralax distortion.

The "Touch Sense" activator allows the operator to hold the pen away from the screen for better visibility of the target. The LP-316 may be ordered in focal lengths ranging from 0.6 to 1.8 inches (0.2-inch increments.

For more information contact Information Control Corp., 9610 Bellanca Ave., Los Angeles, CA 90045, (213) 641-8520.

CIRCLE INQUIRY NO. 158

Textronix 4051 Software

Two new products are available for the Tektronix 4051 Graphics Computer System from Leland C. Sheppard of Sunnyvale, California.

The first is a program development and debugging tool called Documenter-II, which provides formatted listings and several cross-references of 4051 programs on any of several types of output devices.

Prices range from $300 for a single copy to $1,500 for a facilities license for large installations.

The second product is a PERT charting system called Event Scheduling System (ESS). This product employs the Critial Path Method (CPM) of scheduling. ESS has application in any organization with projects to schedule and deadlines to meet.

ESS consists of several programs to build and maintain a project data base and provide charts and reports for the projects on a choice of output devices.

Prices for ESS range from $900 for a single copy to $3,600 for a facilities license for large installations.

The prices for both products include program source and documentation on a cartridge tape, user instructions and one year of maintenance.

For detailed brochure on either product contact Leland C. Sheppart, Dept. I, P.O. Box 60051, Sunnyvale, CA 94086, (408) 733-8651.

CIRCLE INQUIRY NO. 114

Space Byte Offers Modular Business Computers

Space Byte has announced their line of Modular Business Computers complete with business application software priced as pictured at $5,900. The computer has been designed for first time users as well as those with prior computer experience and features complete operator prompting and transparent file maintenance.

The Space Byte "BIZPAK" application software is a report generating system written in assembly language and is complimented by the speed of the Space Byte 8085 CPU. The BIZPAK features interactive program modules for accounts payable, receivable, payroll, and general ledger, and requires only 16K of memory for operation. iCOM FDOS III operating system is included with the system, and additional available software includes Disk Extended BASIC, CP/M and FORTRAN-80.

System hardware includes the SB85-16 Terminal Mounted Mainframe, Space Byte 8085 CPU, 16K Space Byte Fully Static RAM, Hazeltine 1500 video display terminal, iCOM 3712 dual flexible disk drive and floor stand.

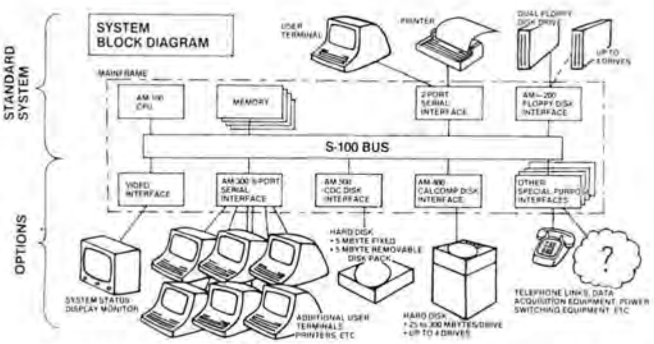
Both hardware and software maintenance contracts are available with overnight component replacement service. Space Byte Modular Business Computers are sold and supported by computer retailers worldwide.

For more information contact The Space Byte Corp., 1720 Pontius Ave., Suite 201, Los Angeles, CA 90025, (213) 468-8080.

CIRCLE INQUIRY NO. 112

CIRCLE INQUIRY NO. 64

AM-100 Introducing the most powerful low-cost computer system you can buy.



The Alpha Microsystems AM-100 is simply years ahead of all other systems in the low-cost computer field. Its versatility and speed make it suitable for a wide variety of uses in business, industry and research, while its extraordinary expandability and upgradeability provide for growth to keep pace with ever expanding applications.

Before the AM-100, timesharing capabilities were available only on minicomputers at three to five times the cost, or on large expensive computer timesharing systems. Its Multi-User Multi-Tasking features enable many people to use the system simultaneously. While one operator is performing accounting functions, another can be employing the text editor and text formatter to generate documents and business letters, and a third can be working on inventory record processing. The system even allows several different jobs to run concurrently under control of a single terminal.

Using the Command Language features, an operator can create a set of instructions which later will cause the system to perform an entire series of tasks automatically. A complex series of jobs can be processed in Batch Mode when this is desired, while the system remains available for other users. The Command Language features can also be used to start the system automatically, eliminating the need for the operator to load any particular program.

The AM-100 handles data storage and retrieval exceptionally well. An advanced file management system makes the AM-100 high level languages efficient in accessing data from floppy or hard disks, yet straightforward to code. Both sequential and random access files are supported, and an ISAM (indexed sequential access mode) package is standard.

The AM-100 is a 16-bit processor based on the universally popular S-100 bus. It features device independent I/O and a printer spooler which can queue up to 16 jobs for printing. BASIC, LISP, PASCAL and FORTH languages are provided. The hard disk system can provide direct access to over one billion bytes of data. System memory requirements can be increased up to maximum of 256 thousand bytes in 16 thousand byte increments, and you suffer no penalty for doing so at a later date.

The AM-100 comes equipped with a remarkably comprehensive set of utilities, all provided free of charge. Whether you need to do text editing, document formatting, program design, high-speed sorting, file copying, or whatever, you'll find the AM-100 utilities ready to do the job.

At Khalsa Computer Systems, we supply exceptional software development tools and thoroughly-checked out custom designed software. We also carry standard business applications software, including General Ledger, Accounts/Receivable, Accounts/Payable, Inventory Control, Payroll, and more. Our experienced personnel provide expert guidance to insure successful integration of your system.

The Alpha Micro Systems, AM-100 represents a major advance in data-processing technology. We at Khalsa Computer Systems honestly believe that the AM-100 now spearheads the computer revolution. Its many powerful features make it the most attractive and affordable system in today's microcomputer market. Write for a full description and detailed look at the specifications of this remarkable system. The free brochure is available from Khalsa Computer Systems, 500 Lake Avenue, Pasadena, California 91101.

THE PROFESSIONAL SYSTEM

Alpha Micro Systems AM-100 CPU in a tabletop chassis featuring brown-out protected power supply and 22 slot S-100 bus. 48K Static RAM. PerSci Model 277 Dual Drive Interface/Controller. 10 Blank Dysan Diskettes. 2-port RS-232 Serial I/O Interface (Includes Cables). Standard Software: Multi-User Multi-Tasking AMOS Operating System, AlphaBASIC Compiler, PASCAL, LISP, and FORTH languages. Relocating Macro-assembler with Linking Loader Text Editor, Text formatter (for word processing), Indexed Sequential Access Method (ISAM), Sort and many other utilities. Includes delivery at location and consultation as per terms of sale. $6,800

Terminal Console, Hazeltine 1500 CRT $1,195

Printer, Texas Instruments 810 150 CPS $1,895

total $ 9,890

System Price $ 9,590

THE SMALL BUSINESS DATA PROCESSING SYSTEM

With 10 Megabyte Hard disk instead of floppy disk

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Board as supplied features power-on jump, parallel I/O port, two serial I/O ports, plus cassette interface.
Zapple Monitor ROM 29.95
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Module/3225-250ns List $995 . 796
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For shipping and insurance, add $10 per mainframe, $3 per floppy disk drive; $2 per board.

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BOOK REVIEWS

8080 PROGRAMMING FOR LOGIC DESIGN

By Adam Osborne
Osborne and Associates, Inc.

Review by Roger H. Edelson
Hardware Editor

This book, a sequel to the two-volume set "An Introduction to Microcomputers," at first appeared rather threatening to me as a hardware/logic designer. Suddenly, the microcomputer threatens to take away my safe little world of NAND/NOR gates and monostable timing circuits, to be replaced by the arcane incantations of CMA (complement accumulator) commands and decrementing timing loops. After reading the book, I realized that what it will do is let me optimize my system/subsystem designs to take advantage of the strengths of each area.

This is a "how-to-do-it" book which will teach a logic designer how to do a portion of his job in a new way — as assembly language programs, and, if you are a programmer it will show you a new use for programming — logic design. What is taught is specifically an implementation of conventional logic design by the application of machine language programs of one specific microcomputer — the 8080A. However, the techniques learned will be transferrable to other microprocessor devices once the underlying principles have been assimilated.

The book begins with the direct simulation of logic devices—inverters, buffers, and HEX inverters. It proceeds with two-input positive AND gates, generalized two-input functions, and three-input functions. At this point it appears to be much like using a steamroller to kill an ant — it works, but is it worth it? It is only after one is shown that a flip-flop is replaced by a single bit in memory, and a monostable multivibrator is equivalent to a three-line program, that the advantage of this technique becomes evident.

In the next chapter, the book looks at a real-life device — the QUME printer. The hardware implementation of the device is investigated and a reasonably direct simulation of the digital logic is attempted. At the end of this chapter, the program simulating the digital logic is presented along with a discussion of the limitations of this one-to-one approach. After this, the printer is viewed as a transfer function to be implemented, and a much simpler program is arrived at. The following chapter discusses efficiencies which the good programmer can bring to this subsystem design — covering subroutines, macros, and the use of interrupts.

Chapter 6 alone is worth the price of admission, as an in-depth coverage of the 8080A Instruction Set, and Chapter 7 concludes the book by providing a number of frequently used subroutines. This feature ought to save the neophyte many hours of labor by removing the need to re-invent the wheel.

The book uses the format pioneered in other volumes of the set with boldface type providing the theme or key sentence, and the material in lightface type expanding on the boldface statement(s).

This book is emminently readable and is recommended to anyone who is tired of playing games on his microcomputer and would like it to do some real work. It is also invaluable to the designer of dedicated microprocessor systems. □

FINITE STATE FANTASIES

By Rich Didday
Matrix Publishers, Inc. 1976

Review by Roger H. Edelson
Hardware Editor

I was tempted to write just a one word review of this book — ugghh!! However, I was afraid that would pique your interest and you might be tempted to actually buy this nonsense.

Basically, the problem is that the book is just not good — the fantasies are infantile, the drawing amateurish, and the educational pieces are too simplistic. To compound the felony, the stylized chip on the front cover and the program on the back give you the illusion that there is something worthwhile inside. To borrow from the introduction, ". . .I'm the type of person who expects things are supposed to mean something."

Again, to use the introduction, this book does indicate the degree of the publisher's commitment — to provide books about *all* aspects of the study and use of computers. He really means it! □

Sunshine Computer Company

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*Special pricing available with full system purchase. **Sunshine Computer Company** specializes in assembled systems. All systems are sold with a 90-day written warranty. Stop in for a demonstration. If you're not nearby, call or write for more information, because **Sunshine Computer Company** ships anywhere in the U.S.

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Sunshine Computer Company

Features

North Star *and* HORIZON-2 | Hazeltine 1500 | *with a Powerful* Disk BASIC

This is a fully integrated dual drive micro-disk system which uses the fastest processor available today, and offers expansion capabilities with the addition of many S-100 bus board options.

Here's how we equip your HORIZON-2 for immediate plug-in operation:

- Z80A processor operates at 4 MHz.
- S-100 bus 12-slot motherboard
- 16K RAM memory at 4 MHz includes error checking and bank switching.
- Dual integrated mini-floppy disk drives.
- Power supply.

To immediately increase your computing capability, we add 2 serial I/O ports: one for your Hazeltine 1500, the other for a printer, or any other peripheral you choose.

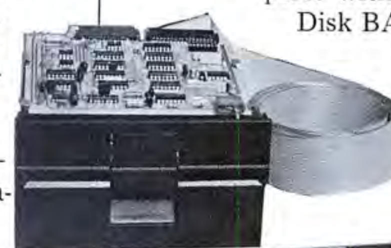
Completely assembled and tested. Just plug it in and compute! Full price for the complete system described here, assembled with 90-day written warranty is $3574.

We add this fine terminal to your HORIZON-2 to give you a complete operating system.

You have a separate numeric keypad and switch-selectable upper and lower case capability—all added to these great features:

- 24x80 display on 12" screen.
- 7x10 dot matrix.
- 8 switch-selectable rates to 19,200 baud.
- Horizontal tabs.
- Brightness control.
- Clear to "End of Line" and "End of Screen".
- Remote cursor stepping.
- Read cursor address.
- Remote keyboard lock.
- RS232 compatible.
- Automatic repeat-all keys.
- Audible alarm.
- Aux. serial output port.

You get your HORIZON-2 and Hazeltine 1500 complete with North Star Disk BASIC.



ADDITIONAL SOFTWARE

Business Package

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Accounts Payable
Accounts Receivable
Payroll
Inventory
Amortization
Mailing List

The entire package is yours with the purchase of the HORIZON-2 System for only $295.

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ASMB Z80 Assembler and Editor - $60
DASMZ Assembler $60
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Drop in and see our own HORIZON-2 and Hazeltine 1500 in operation.

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Card of the Month

The Keyed-Up 8080: An Attractive Alternative Front Panel

By Roger H. Edelson, Hardware Editor

The Keyed-Up 8080™, from Thinker Toys, Berkeley, California, provides another approach to the front panel problem. Halfway between the traditional binary switches/lights and soft front panels, (using a keyboard and display), the Keyed-Up 8080 is an attractive alternative for S-100 bus systems. One can now examine, alter, and monitor the workings of a CPU through a twelve-pad keyboard and an array of ten 7-segment displays. All of this is provided on the same circuit board with a CPU and the necessary control circuitry — a front panel and CPU kit for only $250.00.

This front panel allows the operator to start and stop programs, step programs either manually or at a selectable rate, examine and deposit data to/from memory locations, examine/alter all CPU registers (including the program counter, stack pointer, and program status word), and read from and write into I/O devices. The operator can also monitor the program counter, stack pointer, program status word, CPU registers, memory locations, or I/O devices as the program executes at a selectable rate. All this is presented in a byte-oriented octal format from a virtually crash-proof system. The operating system is contained in 256 bytes of ROM and requires an additional 256 bytes of RAM. This memory is provided on the board and uses the top 512 spaces of the 65K address map. The system block diagram is shown in Figure 1.

THE COMPONENTS

The kit provides an S-100 compatible single board combining all the pieces necessary for a front-panel and a CPU board. This saves one card slot on the motherboard with an actual increase in capability. The board is well constructed with an epoxy glass base, double-sided tinned etch with plated through holes, gold-flashed edge

One can now examine, alter and monitor the workings of a CPU through a twelve-pad keyboard and an array of ten 7-segment displays. All of this is provided on the same circuit board with a CPU and the necessary control circuitry.

connector, and solder masked. The cherry keyswitches have gold contacts for reliability. Also included are ten 7-segment .4 inch displays. The 8080A supplied is a ceramic 8080AD from National. The clock is produced by an 8224 clock driver for reliable operation and minimum parts. The board is fully socketed for the total of 39 integrated circuits.

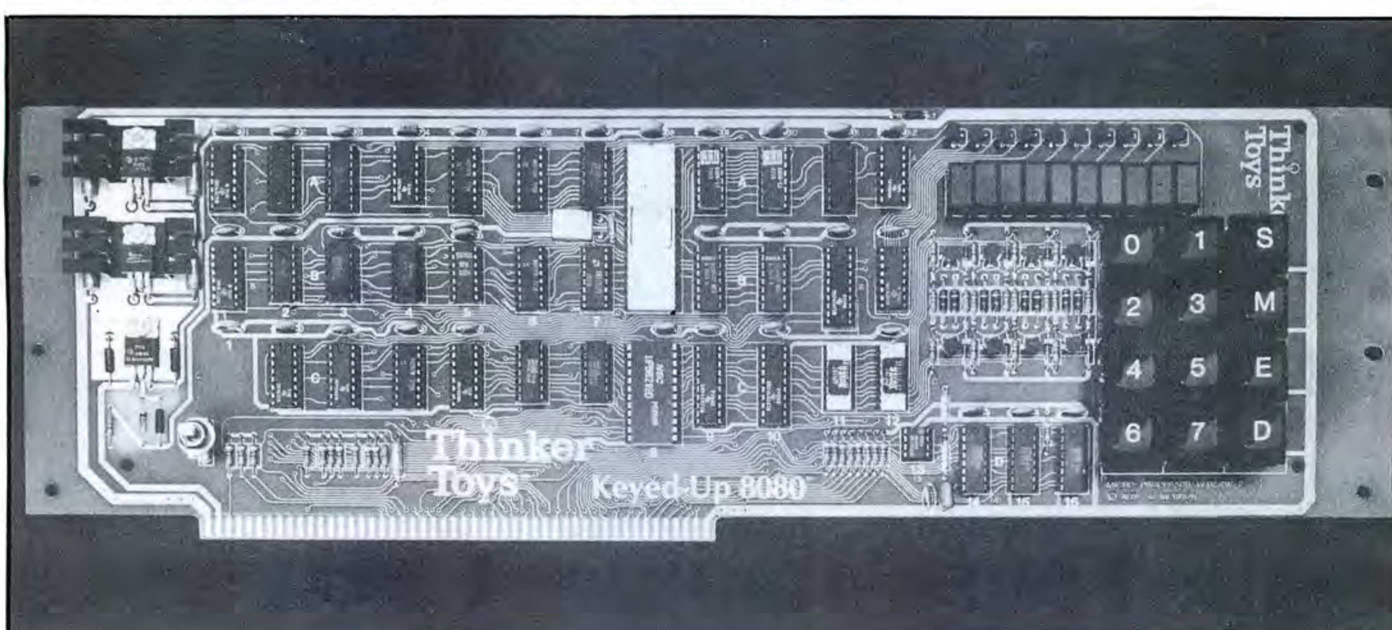


PHOTO 1

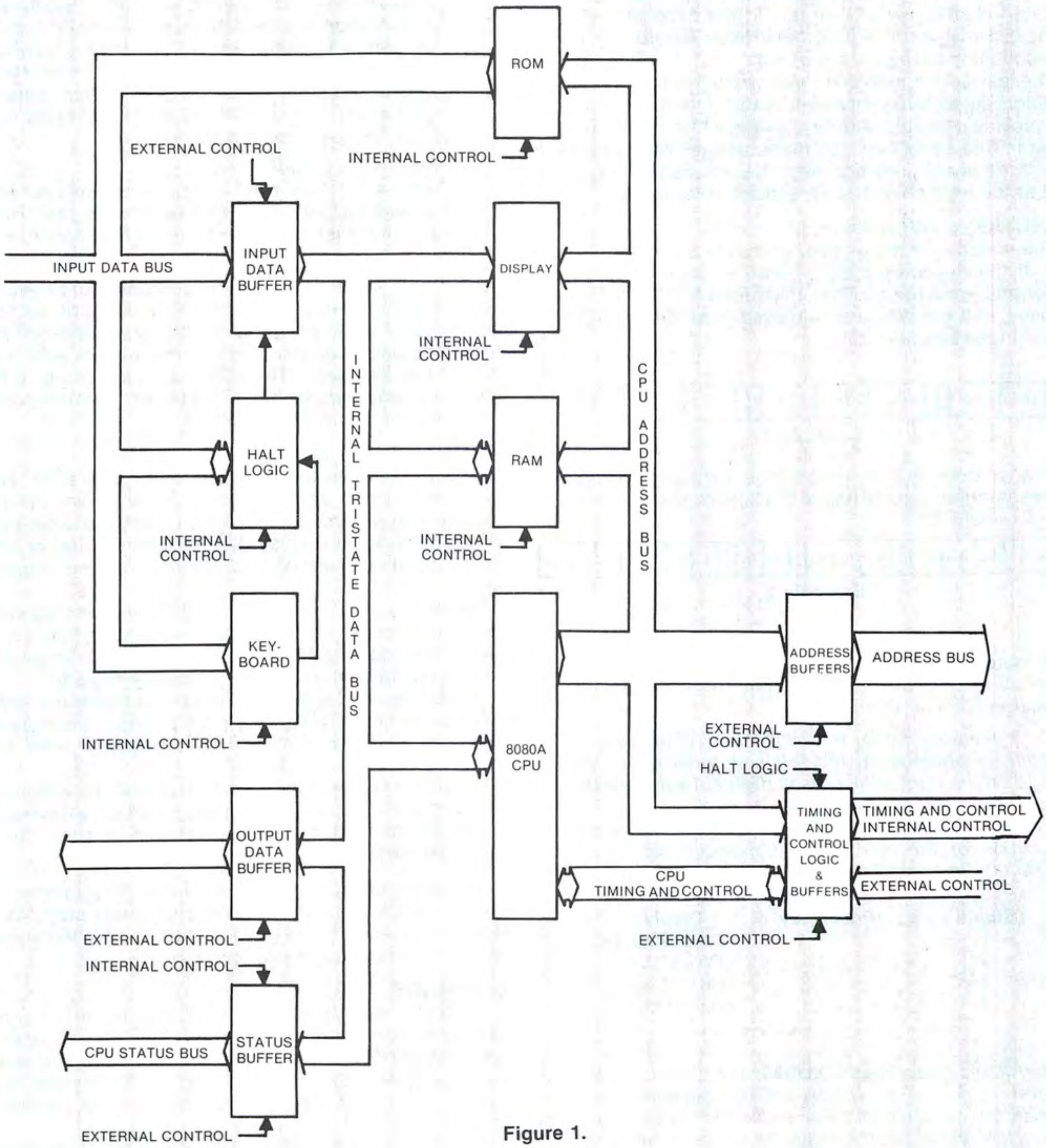

ROM
INTERNAL CONTROL
EXTERNAL CONTROL
INPUT DATA BUFFER
INPUT DATA BUS
DISPLAY
INTERNAL CONTROL
INTERNAL TRISTATE DATA BUS
CPU ADDRESS BUS
HALT LOGIC
RAM
INTERNAL CONTROL
INTERNAL CONTROL
KEY-BOARD
ADDRESS BUFFERS
ADDRESS BUS
INTERNAL CONTROL
8080A CPU
EXTERNAL CONTROL
HALT LOGIC
TIMING AND CONTROL LOGIC & BUFFERS
TIMING AND CONTROL INTERNAL CONTROL
OUTPUT DATA BUFFER
CPU TIMING AND CONTROL
EXTERNAL CONTROL
EXTERNAL CONTROL
EXTERNAL CONTROL
INTERNAL CONTROL
STATUS BUFFER
CPU STATUS BUS
EXTERNAL CONTROL

Figure 1.

Construction of the board took about 2 hours, with everything but the key-switches going together quite easily. The key-switches were difficult as one pin makes a very tight fit. One of the thinner leads broke off, but had enough of the lead left to make the connection. The board has almost no component marking with the exception of a matrix grid for identification of the integrated circuit locations. An outline of each component is shown, but no part number or identification is provided on the board. This function is filled by the almost full-sized layout diagram in the excellent user's manual. However, it would have been helpful to have component marking on the board.

The instruction manual is well written, and provides a bending guide for component leads. The manual does not provide a trouble-shooting guide, which makes it difficult to find a problem. The manufacturer does suggest that if the board does not meet the requirements specified in the final checklist, to send it in for repair.

FUNCTIONS AVAILABLE

The majority of the 64-page manual is devoted to the use of the Keyed-Up 8080. Therefore, let's look at the functions provided. The instructions, instruction classes, and the data are displayed in an octal 2-3-3 bit pattern (see Example 1).

D_7	D_6		D_5	D_4	D_3		D_2	D_1	D_0

Example 1

The addresses are arranged in a byte-oriented octal representation, which has a 2-3-3-2-3-3 pattern of bits (see Example 2).

A_{15}	A_{14}		A_{13}	A_{12}	A_{11}		A_{10}	A_9	A_8		A_7	A_6		A_5	A_4	A_3		A_2	A_1	A_0

Example 2

This representation creates a rather unusual situation, when addresses are entered from the keyboard. The manual explains it this way:

"In memory mode, the front panel displays six digits of address on the left and three digits of data on the right with a blank digit between which serves as a field separator.

The first example will be to examine the first location of the last page of memory, which is 377.000. Do the following:

Step #	*Press Key*	*Display*
1	*3*	*000 003 XXX**
2	*7*	*000 037 XXX*
3	*7*	*000 377 XXX*
4	*0*	*003 370 XXX*

**Contents of location zero on page zero.*

The display now reads 003370. The first entered seven is now displayed as a three. However, the seven has not been lost. Each time a key is pressed, the front panel logic creates an address ***within*** *a page from the last three digits entered and creates a page number from the rest of the digits. When step 4 was completed, 7, 7, and 0 were the last three digits entered. The front panel is programmed to discard the overflow if the last three digits do not fit into 8 bits. 370 is the number left after the overflow bit of 770 is discarded. In general, when a digit larger than three is moved into the most significant digit of the least significant byte, it is temporarily trimmed: 4 is trimmed to 0, 5 to 1, 6 to 2, and 7 to 3.*

Step #	*Press Key*	*Display*
5	*0*	*037 300 XXX*
6	*0*	*377 000 XXX*
7	*E*	*377 000 347*

The display should now read 377001 346. 346 is the content of memory location 377001. Step 8 caused the front panel to perform an "examine next" operation. The E key is used to execute "examine" and "examine next" operations. An "examine next" operation will be performed whenever the E key is pressed subsequent to the D or E having been pressed with no digits pressed in between. There is an exception to this when the front panel is in I/O mode. In I/O mode, there is no "examine next" or "deposit next" operation.

Point to remember:

Digits 4, 5, 6, and 7 are temporarily displayed as 0, 1, 2, and 3 when shifted into the most significant digit of the least significant byte (4th display from the left)."

This procedure causes some confusion until you get used to it. Remember to put in all six digits of the octal address and it will be all right. Also, the addresses now arrange themselves into 256 member groups, which are referred to as pages. The 8080 can address up to 65K locations, which works out to 256 pages where each page contains 256 separate addresses.

FRONT PANEL MODES

The front panel has four modes of operation, each designed to give the user more control over the processor. The first mode, mode 0, is used to examine and fill memory, or to display the program counter and the contents of memory being pointed to during single or slow steps.

Mode 1 is used to examine and fill the CPU registers, program counter, stack pointer, and the program status word. This mode is also used during slow or single step to display the last examined processor register.

Mode 2 is used with I/O devices and reads and writes to those devices. This mode is also used to examine the last data from the device during single or slow step operation.

The final mode is Mode 3, which allows the user to examine and fill memory, and display the last data and address of the last examined memory location during single or slow step operation.

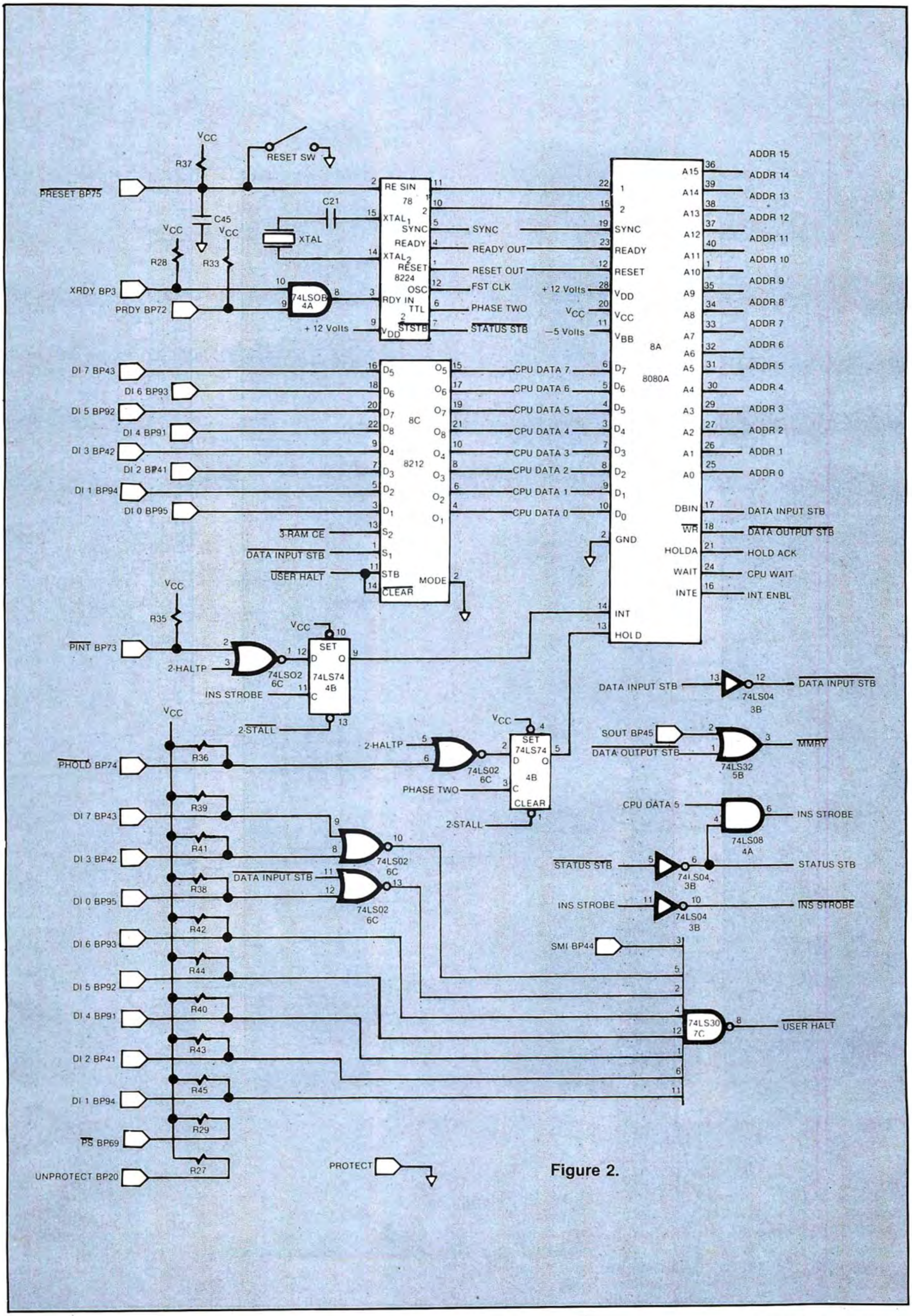
The front panel controls all modes of operation, including the setting of the slow and single step operations. The panel is designed to collect and display the last six digits entered from the key pad.

SUMMARY

Basically, what has been provided is a minicomputer-like control on the microcomputer. This control logic is completely transparent to the user software and is absolutely crash proof. The only cost is 512 address locations at the top of the address space and the necessity to think in OCTAL.

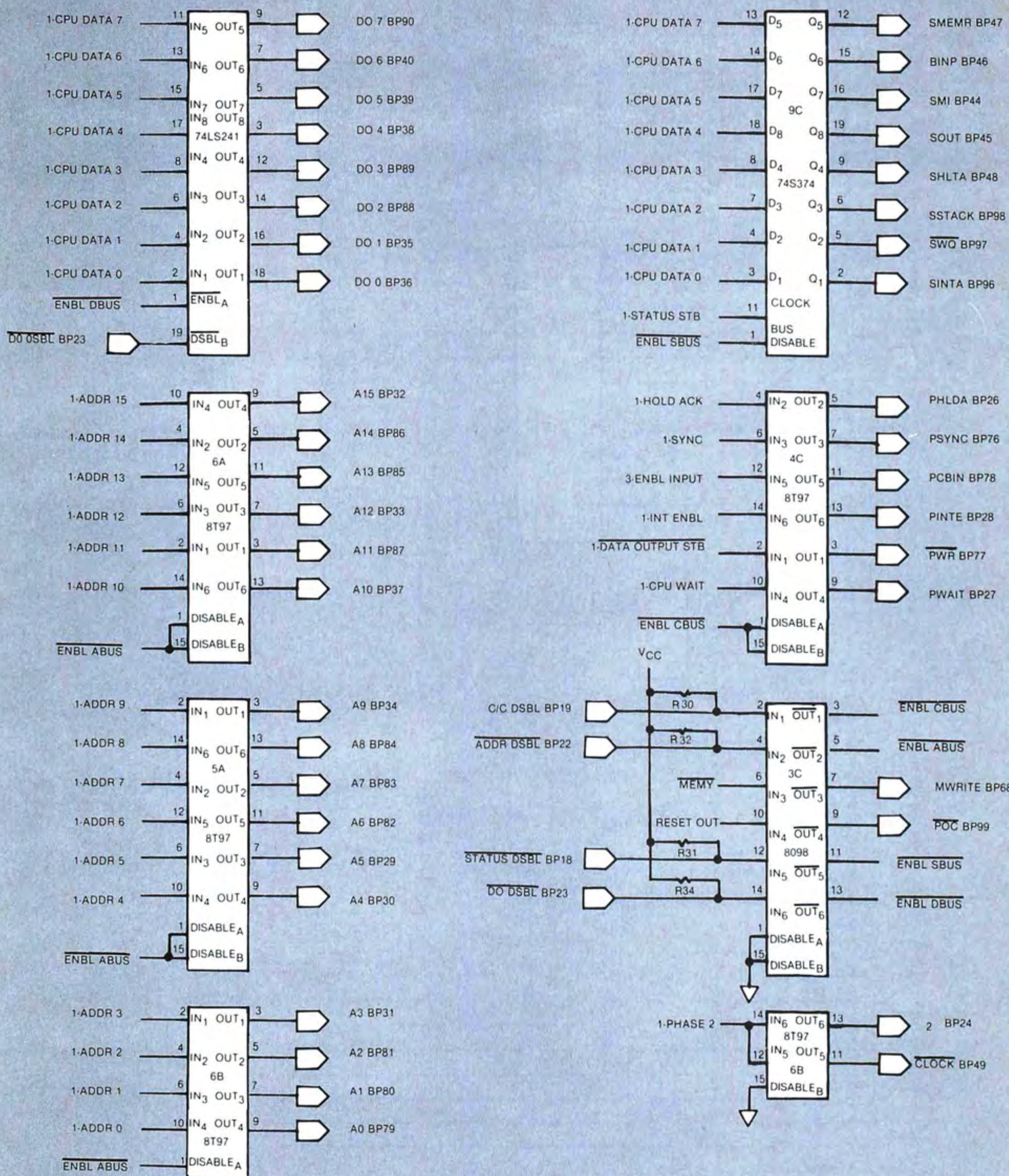
Figures 2 through 7 show the entire logic of the board. As you can see, all lines are fully buffered with enough output capability to drive 30 TTL loads. One point that is made is that memories which do not use the PDBIN signal to strobe memory data onto the input bus will not work properly with the Keyed-Up 8080. There is sufficient unused logic in these boards to implement the simple fixes required.

The Keyed-Up 8080 should be very carefully considered as an alternative to the more standard front-panel CPU combinations. The features are fantastic at a very good price and the workmanship is excellent.□



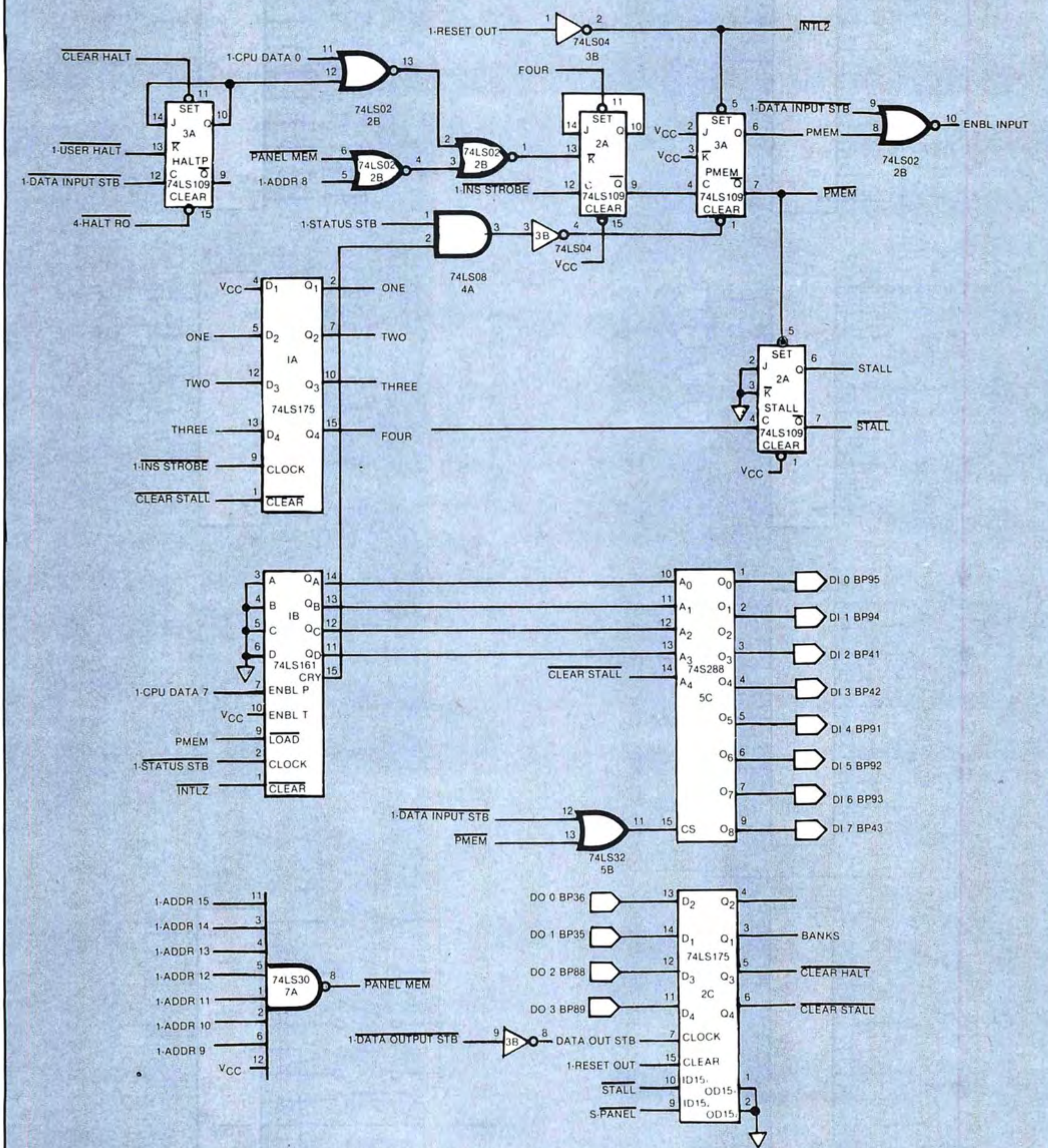
RESET SW
XTAL
8224
8212
8080A
74LS08
74LS02
74LS74
74LS04
74LS32
74LS30
USER HALT
PROTECT

Figure 2.



74LS241
74S374
9C
6A
8T97
4C
5A
3C
8098
6B
Vcc
R30
R32
R31
R34
1-CPU DATA 7
1-CPU DATA 6
1-CPU DATA 5
1-CPU DATA 4
1-CPU DATA 3
1-CPU DATA 2
1-CPU DATA 1
1-CPU DATA 0
ENBL DBUS
DO DSBL BP23
DO 7 BP90
DO 6 BP40
DO 5 BP39
DO 4 BP38
DO 3 BP89
DO 2 BP88
DO 1 BP35
DO 0 BP36
1-STATUS STB
ENBL SBUS
SMEMR BP47
BINP BP46
SMI BP44
SOUT BP45
SHLTA BP48
SSTACK BP98
SWO BP97
SINTA BP96
1-ADDR 15
1-ADDR 14
1-ADDR 13
1-ADDR 12
1-ADDR 11
1-ADDR 10
ENBL ABUS
A15 BP32
A14 BP86
A13 BP85
A12 BP33
A11 BP87
A10 BP37
1-HOLD ACK
1-SYNC
3-ENBL INPUT
1-INT ENBL
1-DATA OUTPUT STB
1-CPU WAIT
ENBL CBUS
PHLDA BP26
PSYNC BP76
PCBIN BP78
PINTE BP28
PWR BP77
PWAIT BP27
1-ADDR 9
1-ADDR 8
1-ADDR 7
1-ADDR 6
1-ADDR 5
1-ADDR 4
A9 BP34
A8 BP84
A7 BP83
A6 BP82
A5 BP29
A4 BP30
C/C DSBL BP19
ADDR DSBL BP22
MEMY
RESET OUT
STATUS DSBL BP18
DO DSBL BP23
ENBL CBUS
ENBL ABUS
MWRITE BP68
POC BP99
ENBL SBUS
ENBL DBUS
1-ADDR 3
1-ADDR 2
1-ADDR 1
1-ADDR 0
A3 BP31
A2 BP81
A1 BP80
A0 BP79
1-PHASE 2
2 BP24
CLOCK BP49

Figure 3.



1-RESET OUT
74LS04
3B
INTL2
CLEAR HALT
1-CPU DATA 0
74LS02
2B
FOUR
SET
3A
HALTP
74LS109
CLEAR
1-USER HALT
1-DATA INPUT STB
4-HALT RQ
PANEL MEM
1-ADDR 8
2A
1-INS STROBE
PMEM
1-DATA INPUT STB
ENBL INPUT
1-STATUS STB
74LS08
4A
VCC
ONE
TWO
THREE
IA
74LS175
CLOCK
CLEAR STALL
CLEAR
STALL
IB
74LS161
CRY
1-CPU DATA 7
ENBL P
ENBL T
LOAD
74S288
5C
CS
DI 0 BP95
DI 1 BP94
DI 2 BP41
DI 3 BP42
DI 4 BP91
DI 5 BP92
DI 6 BP93
DI 7 BP43
74LS32
5B
1-ADDR 15
1-ADDR 14
1-ADDR 13
1-ADDR 12
1-ADDR 11
1-ADDR 10
1-ADDR 9
74LS30
7A
DO 0 BP36
DO 1 BP35
DO 2 BP88
DO 3 BP89
2C
BANKS
1-DATA OUTPUT STB
DATA OUT STB
S-PANEL

Figure 4.

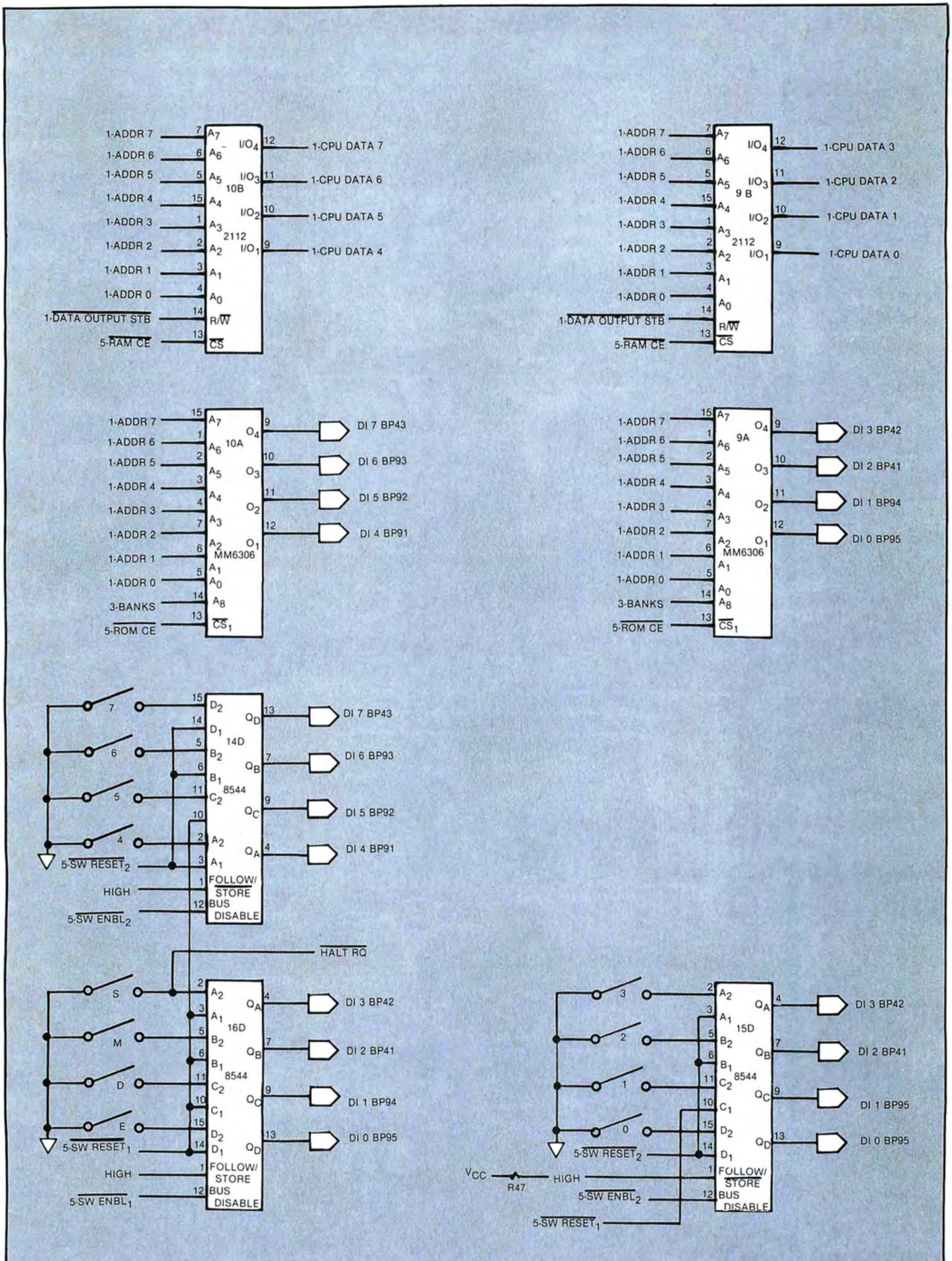

1-ADDR 7
1-ADDR 6
1-ADDR 5
1-ADDR 4
1-ADDR 3
1-ADDR 2
1-ADDR 1
1-ADDR 0
1-DATA OUTPUT STB
5-RAM CE
10B
2112
9 B
1-CPU DATA 7
1-CPU DATA 6
1-CPU DATA 5
1-CPU DATA 4
1-CPU DATA 3
1-CPU DATA 2
1-CPU DATA 1
1-CPU DATA 0
3-BANKS
5-ROM CE
10A
9A
MM6306
DI 7 BP43
DI 6 BP93
DI 5 BP92
DI 4 BP91
DI 3 BP42
DI 2 BP41
DI 1 BP94
DI 0 BP95
14D
8544
5-SW RESET2
HIGH
5-SW ENBL2
FOLLOW/STORE
BUS DISABLE
HALT RQ
16D
15D
5-SW RESET1
5-SW ENBL1
VCC
R47
DI 1 BP95

Figure 5.

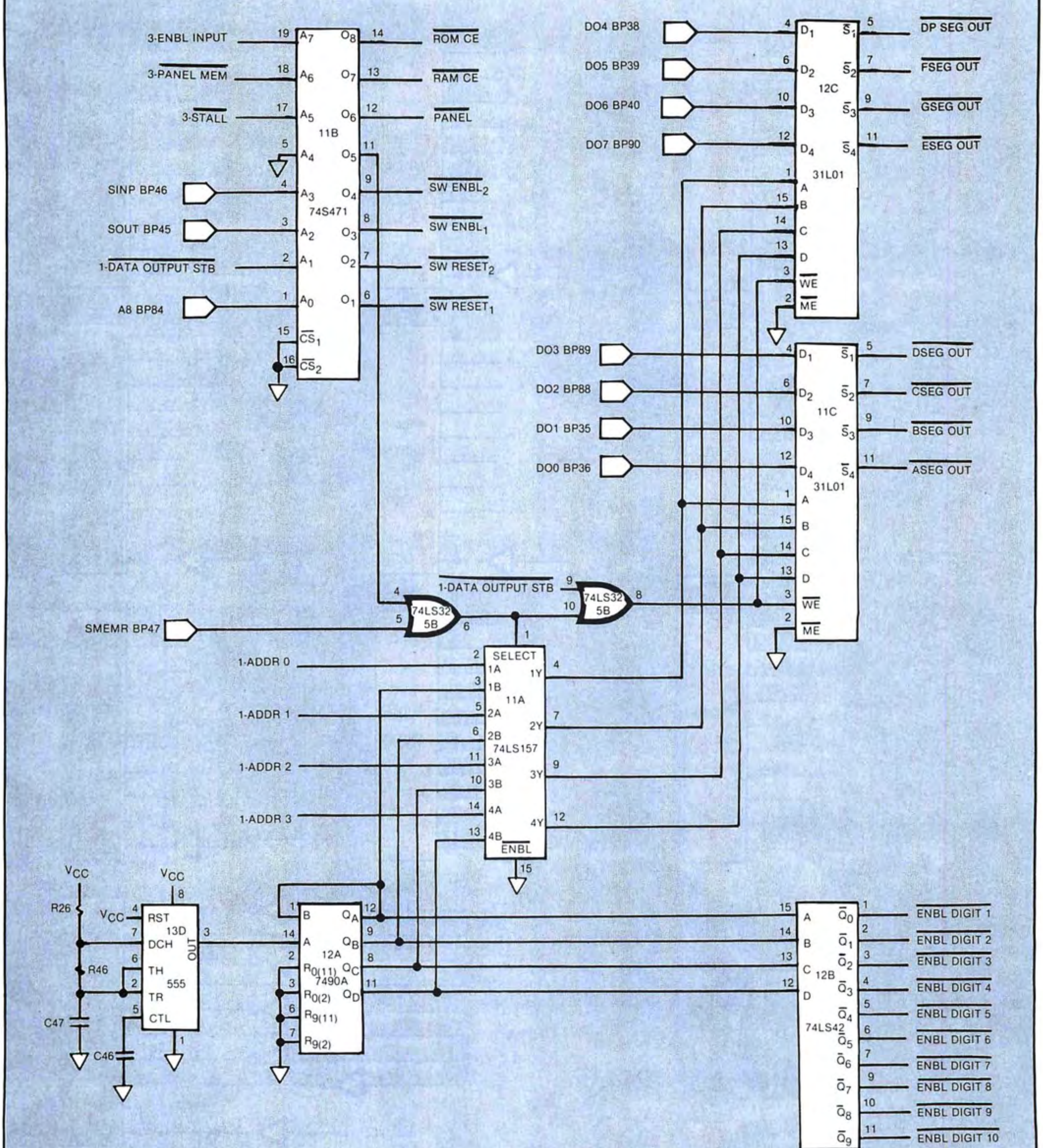

3-ENBL INPUT
3-PANEL MEM
3-STALL
SINP BP46
SOUT BP45
1-DATA OUTPUT STB
A8 BP84
11B
74S471
ROM CE
RAM CE
PANEL
SW ENBL2
SW ENBL1
SW RESET2
SW RESET1
DO4 BP38
DO5 BP39
DO6 BP40
DO7 BP90
12C
31L01
DP SEG OUT
FSEG OUT
GSEG OUT
ESEG OUT
DO3 BP89
DO2 BP88
DO1 BP35
DO0 BP36
11C
31L01
DSEG OUT
CSEG OUT
BSEG OUT
ASEG OUT
SMEMR BP47
74LS32
5B
1-DATA OUTPUT STB
SELECT
11A
74LS157
ENBL
1-ADDR 0
1-ADDR 1
1-ADDR 2
1-ADDR 3
VCC
R26
R46
C47
C46
13D
555
RST
DCH
TH
TR
CTL
OUT
12A
7490A
12B
74LS42
ENBL DIGIT 1
ENBL DIGIT 2
ENBL DIGIT 3
ENBL DIGIT 4
ENBL DIGIT 5
ENBL DIGIT 6
ENBL DIGIT 7
ENBL DIGIT 8
ENBL DIGIT 9
ENBL DIGIT 10

Figure 6.

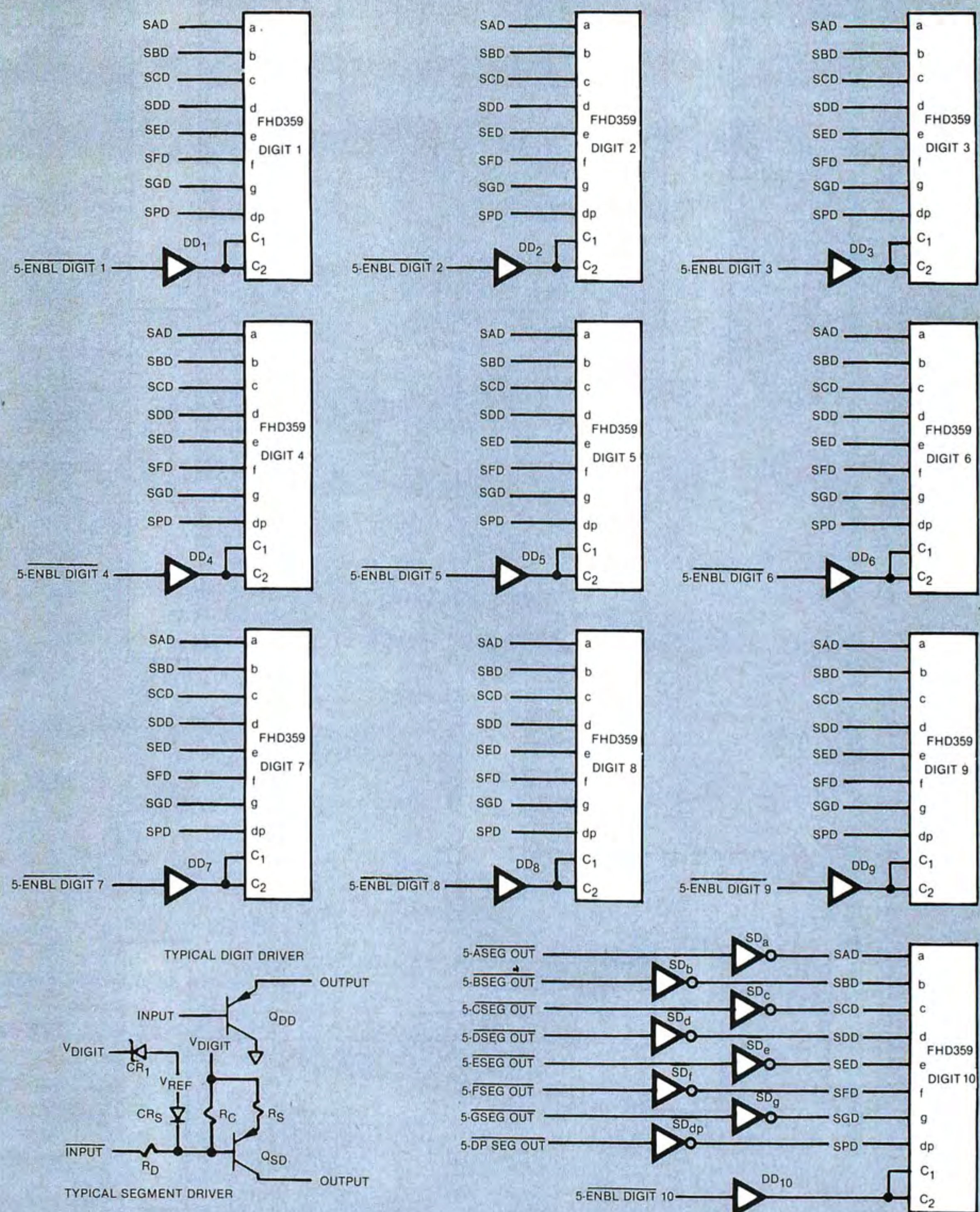

SAD
SBD
SCD
SDD
SED
SFD
SGD
SPD
a
b
c
d
e
f
g
dp
C_1
C_2
FHD359
DIGIT 1
DIGIT 2
DIGIT 3
DIGIT 4
DIGIT 5
DIGIT 6
DIGIT 7
DIGIT 8
DIGIT 9
DIGIT 10
DD_1
DD_2
DD_3
DD_4
DD_5
DD_6
DD_7
DD_8
DD_9
DD_{10}
5-$\overline{\text{ENBL DIGIT}}$ 1
5-$\overline{\text{ENBL DIGIT}}$ 2
5-$\overline{\text{ENBL DIGIT}}$ 3
5-$\overline{\text{ENBL DIGIT}}$ 4
5-$\overline{\text{ENBL DIGIT}}$ 5
5-$\overline{\text{ENBL DIGIT}}$ 6
5-$\overline{\text{ENBL DIGIT}}$ 7
5-$\overline{\text{ENBL DIGIT}}$ 8
5-$\overline{\text{ENBL DIGIT}}$ 9
5-$\overline{\text{ENBL DIGIT}}$ 10
TYPICAL DIGIT DRIVER
INPUT
OUTPUT
Q_{DD}
V_{DIGIT}
CR_1
V_{REF}
CR_S
R_C
R_S
$\overline{\text{INPUT}}$
R_D
Q_{SD}
OUTPUT
TYPICAL SEGMENT DRIVER
5-$\overline{\text{ASEG OUT}}$
5-$\overline{\text{BSEG OUT}}$
5-$\overline{\text{CSEG OUT}}$
5-$\overline{\text{DSEG OUT}}$
5-$\overline{\text{ESEG OUT}}$
5-$\overline{\text{FSEG OUT}}$
5-$\overline{\text{GSEG OUT}}$
5-$\overline{\text{DP SEG OUT}}$
SD_a
SD_b
SD_c
SD_d
SD_e
SD_f
SD_g
SD_{dp}

Figure 7.

Now, a complete business computing system for only $5995

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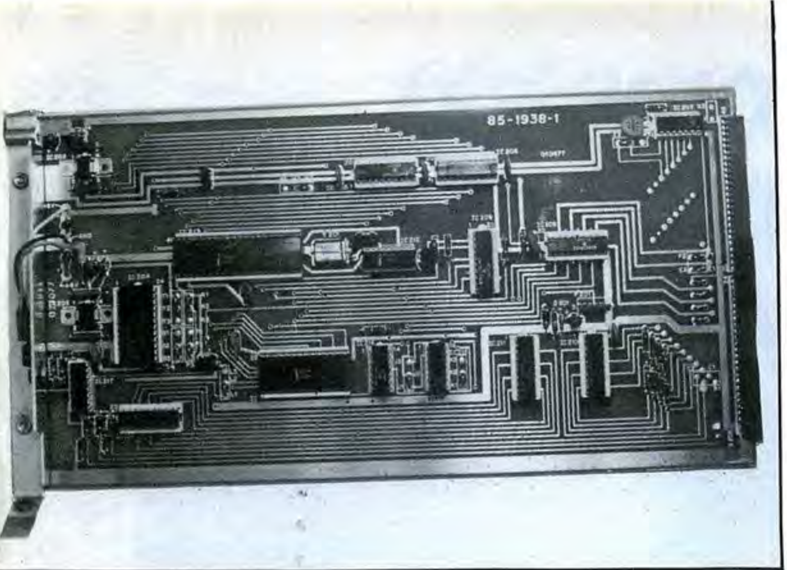

PHOTO 1 The H8 CPU board. 50-pin connector socket is at right; voltage regulator heat sink/card support bracket is at left.

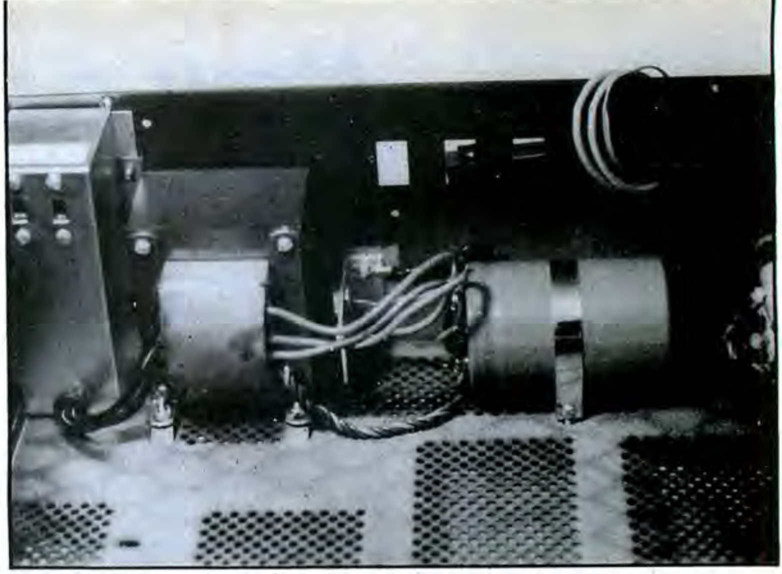

PHOTO 2 The H8 power supply. Capacitor is covered with a shield after installation (see Photo 3). Slide switches at left select 120V/240V and regular/low-voltage operation.

A Buyer's and Builder's Guide

INTRODUCTION

The announcement last summer, and arrival last fall, of the Heathkit H8 microcomputer system have generated a great deal of speculation, discussion and controversy. This article will give you my analysis of the pros and cons of the H8 versus other popular microcomputer systems and a description of my experience in building this system. A separate article will cover what I feel are the strengths and weaknesses of the system in home, hobby and business applications.

THE H8 SYSTEM

The Heathkit H8 is an 8-bit general purpose microcomputer. It is housed in a black cabinet with a gray face; the cabinet measures 16"W x 17.5"D x 6.5"H. The basic computer includes the front panel/monitor and CPU cards, the mother board and power supply, and in that configuration weighs approximately 21 pounds.

The H8 uses an 8080A microprocessor running at 2.048 MHz. The CPU board (Photo 1) is supplied fully assembled and tested. Seven priority vectored interrupts are available, and DMA capability is included.

The H8 has a 10 amp power supply (Photo 2) which operates at either 120 or 240 VAC (switch selectable). An additional switch allows operation at normal or reduced input voltage. The power supply can handle 32K of RAM and 3 I/O cards in addition to the CPU and front panel cards. Cooling is by convection, rather than forced-air fan. The power supply uses a 77,000 μf filter capacitor for ripple-free DC output.

The motherboard (Photo 3) runs vertically along the right side of the cabinet. Ten slots are provided; the front panel and CPU boards occupy the first two, and the last slot is reserved for an expansion connector. Seven slots are thus available for memory, I/O and other cards.

Cards are mounted in the computer at an angle of about 30° back from the vertical; female connectors on the cards insert onto the male pins extending outward from the bus. Each card is additionally supported on its left-hand side by screws connecting it to the bottom of the cabinet and to a support bracket running along the top of the cards (Photo 4). The left edge of each card consists of a full-length aluminum heat sink, with screwholes at the top and bottom for mounting; each card contains its own on-board voltage regulators. The result is a very strong mounting system, which also provides very good heat dissipation.

Most boards are etched on both sides, most are solder masked, and all are fully screened with component designations. Sockets are provided for all IC's.

The H8 uses a 50-line bidirectional bus (see Figure 1). This bus is not compatible with the S100 unidirectional bus used in the Altair, Imsai, and other systems.

The H8 contains a resident monitor in 1Kx8 ROM. The monitor supports the front panel (Photo 5), which contains four status LEDs, nine 7-segment LED displays, and a 16-key keyboard.

The four status LEDs are labeled ION, MON, RUN, and PWR. The ION LED indicates that the CPU is accepting interrupts. The MON LED indicates that you have control from the front panel. The RUN LED indicates that the CPU is in a run condition. The PWR LED indicates that +5 volts is present at the front panel.

The nine 7-segment LED displays and the 16-key keyboard allow you to display, input and alter the contents

PHOTO 3 The H8 motherboard. Front panel connects to P1; CPU board plugs into P2. P10 is reserved for an expansion connector.

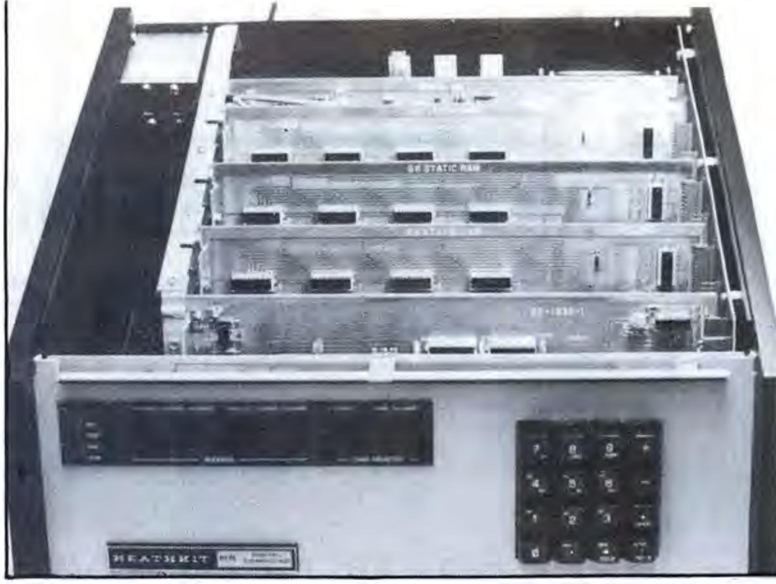

PHOTO 4 The completed H8 with top cover removed. The CPU, three 8K RAM boards, and the serial I/O and cassette interface boards are installed from front to back. Card mounting bracket is at top left.

to the Heathkit H8 System

By Richard S. Arnold

of registers, the program counter, the accumulator, and any memory location. Data and addresses can also be displayed during input from tape. The front panel also allows you to load and dump to and from memory, and control input and output ports. Additionally, it allows monitoring of tape loads and dumps, resetting the computer, and executing programs. A CRC check is automatically performed during loads from tape.

You can single step through a program via the front panel keyboard, incrementing and decrementing memory locations as desired. An automatic repeat function allows you to step forward or backward at a 2.5 Hz rate if desired. A program may be stopped during execution, and control returned to the front panel monitor, without destroying information in the CPU registers or the serial and parallel ports.

A built-in speaker provides a useful audio signal. A short beep verifies each key stroke; a medium beep verifies successful address or data byte completion; and a long beep verifies a master reset or indicates an illegal command.

The nine 7-segment LEDs display address and data information in octal formal (Photo 6). Sixteen-bit numbers, such as memory addresses, are displayed as two 8-bit numbers in offset octal. Thus, the binary number 11 111 111 is displayed as 377, and the binary number 11 111 111 01 111 111 is displayed as 377 177.

Full keyboard debounce logic is provided. While a program is being executed, only the RST (reset) and RTM (return-to-monitor) keys will operate. Both of these commands require the simultaneous pressing of the indicated key and the 0 key, a nice feature to prevent inadvertent halting or destruction of a program. While a program is running, apart from these two commands the program itself may fully utilize the keyboard.

The sophistication of the front panel/monitor makes it very useful in debugging and modifying programs. It is a well-thought-out compromise between a front panel with nothing but power and reset keys versus one with rows of toggle switches and LEDs, it offers features not available with either of these other approaches.

Software is supplied with the H8 at no additional cost in audio cassette form. It is also available in paper tape form for an additional $20. An extended version of BASIC is available in cassette or paper tape form for an additional $10.

The assembly manual for the H8 is, as you would expect from Heath, very detailed and well organized. Also included are a separate operating manual for the H8 and a comprehensive reference manual for the various items of system software.

H8 ACCESSORIES

At this writing, Heath has three stand-alone accessories available: the H9 video terminal, the H10 paper tape reader/punch, and the H36, which is the DEC Writer II keyboard printer terminal. As I only have experience with the H9, which is described below, the other two peripherals will not be discussed.

Three H8 accessory cards are also currently available from Heath: a RAM board, a parallel interface board, and a serial I/O and cassette interface board.

The RAM board (Photo 7) is available in a 4K configuration, and can be expanded to 8K with a separately avail-

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CIRCLE INQUIRY NO. 67

Pin	Signal	Pin	Signal
49	+8V	24	GND
48	+18V	23	MEMW
47	+18V	22	$\overline{02}$
46	$\overline{\text{ROM DISABLE}}$	21	I/OW
45	$\overline{A_{15}}$	20	RDYIN
44	$\overline{A_{14}}$	19	M1
43	$\overline{A_{13}}$	18	$\overline{D_7}$
42	$\overline{A_{12}}$	17	$\overline{D_6}$
41	$\overline{A_{11}}$	16	$\overline{D_5}$
40	$\overline{A_{10}}$	15	$\overline{D_4}$
39	$\overline{A_9}$	14	$\overline{D_3}$
38	$\overline{A_8}$	13	$\overline{D_2}$
37	$\overline{A_7}$	12	$\overline{D_2}$
36	$\overline{A_6}$	11	$\overline{D_1}$
35	$\overline{A_5}$	10	$\overline{D_0}$
34	$\overline{A_4}$	9	$\overline{INT_2}$
33	$\overline{A_3}$	8	$\overline{INT_1}$
32	$\overline{A_2}$	7	$\overline{INT_7}$
31	$\overline{A_1}$	6	$\overline{INT_6}$
30	$\overline{A_0}$	5	$\overline{INT_5}$
29	$\overline{\text{RESET}}$	4	$\overline{INT_4}$
28	MEMR	3	$\overline{INT_3}$
27	HOLD	2	-18V
26	I/OR	1	GND
25	HLDA	0	GND

Figure 1. The H8 50-line bus. Pin numbers correspond to those at each location along the motherboard (see Photo 3; pin no. 49 is at the top. Heath has reserved the right to change the designations of pins 8, 9, 18, 24, 25 and 27.

able chip set. The RAM board uses TMS-4044, 4Kx1 static chips. Maximum access time is given as 450 nsec. All inputs are 1 TTL load or less, the data out lines are fully buffered, and a full complement of bypass capacitors is included. Memory address assignment is selected by a jumper, along 8K boundaries. Like all H8 cards, each memory board contains its own voltage regulators. Current requirements are .75 amperes for 4K and 1.25 amperes for 8K.

The parallel interface board has three independent parallel ports, each with eight bits input and eight bits output plus universal handshake capability. Maximum transfer time is given as 390 μsec.

The serial I/O and cassette interface board (Photo 8) is used to connect the H8 to serial devices such as the H9 video terminal and also to one or two cassette recorders. The serial interface operates at data rates from 110 to 9600 baud, selected by jumper. Output levels, selected by jumpers, can be set to either 20 MA current loop or RS-232C compatible levels. The on-board USART can be programmed for 5- through 8-bit character length, one, one-half or two stop bits, and odd, even or no parity. The cassette interface data rate is jumper-selectable to 300 to 1200 baud. Recording and playback utilize the BYTE/"Kansas City" format. Control lines are provided for remotely starting and stopping two separate cassette units to allow separate recording and playback if desired. An on-board LED test circuit is provided for adjusting the PLL synthesizer and space detector in the cassette interface circuit.

Heathkit recommends, and will only assure proper operation of the cassette interface and the H8 software with, a Heath-supplied cassette recorder. This recorder is a GE model 3-5121; you may be able to purchase it elsewhere at a price less than the $55 quoted by Heath.

THE H9 VIDEO TERMINAL

The Heathkit H9 video terminal (Photo 9) is designed to match the H8 computer in appearance and performance. However, the H9 is a stand-alone peripheral, and can be used with any computer or in a time-sharing system.

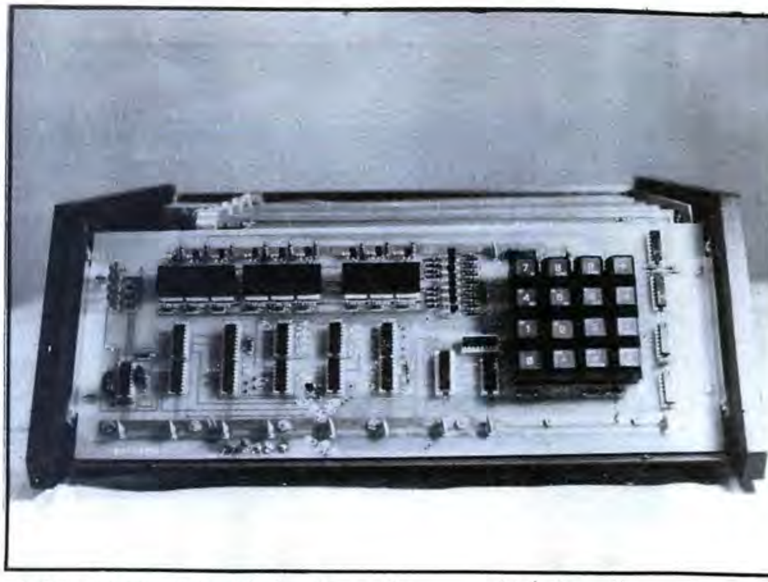

PHOTO 5 The H8 with front panel removed to show the front panel card.

PHOTO 6 The H8 front panel display LEDs. RAM location 104 057₈ has contents 102₈.

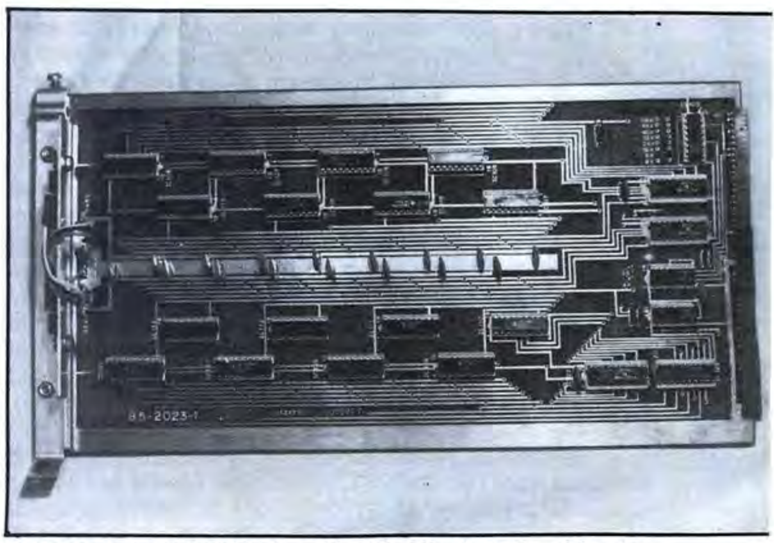

PHOTO 7 An H8 RAM board with 8K of static chips installed. Note bypall capacitors and double voltage regulators. Address selection jumper is at upper right.

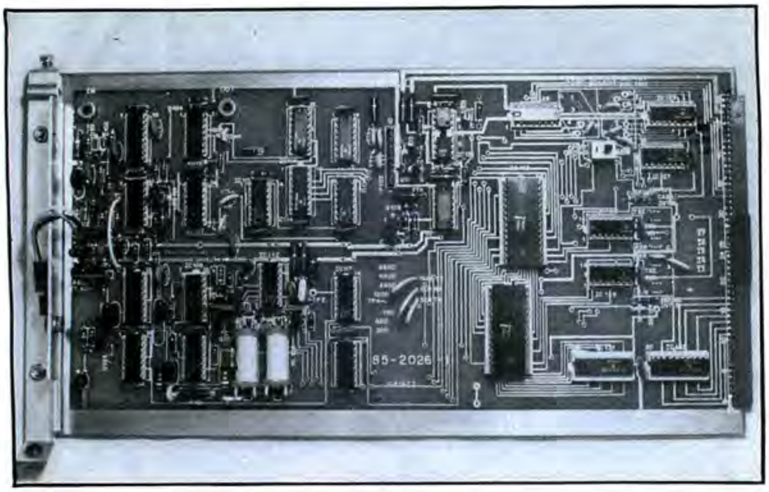

PHOTO 8 The H8 serial I/O and cassette interface board. Note the multitude of jumpers, described in text. The LED used for alignment is to the right of the second IC from the top in the left hand row.

PHOTO 9 The completed H9 terminal. Keyboard follows standard layout. Most special function keys are in the top row.

The H9 is housed in a black high-impact plastic cabinet with a gray faceplace surrounding the keyboard. The terminal measures 12½"H x 15⅝"W x 20¾"D; it weighs a hefty 32 pounds. The power supply is designed to operate from either 120 or 240 VAC. The dual primary windings of the power transformer may be wired in parallel for 120-volt operation or in series for 240-volt operation during construction of the kit.

The 12" diagonal CRT has 12 kV on its anode and provides a clear, bright display. There is no noticeable flickering and focus is uniform across the screen.

A jumper on the H9 video circuit board can be connected to select one of three separate display widths (normal, wide, and extra wide). The wide and extra wide settings are provided for use in low line voltage situations; the normal setting will provide the correct display width under normal circumstances.

Centering of the display is accomplished by rotating the centering magnets on the CRT yoke. The adjustment is not overly critical, and I was able to achieve a very good compromise between centering and linearity with little difficulty.

Potentiometers are mounted on the video circuit board for adjusting the focus, brightness and height of the CRT display. It is necessary to remove the cabinet shell to make these adjustments. If the height of the display is too great, the dots that form individual characters become more apparent, and thus a compromise has to be reached between display size and the sharpness of the characters.

The brightness and focus of the display are interrelated, and adjusting one will probably necessitate adjusting the other as well. Too bright a display will, over long periods of time, become tiring on your eyes; there also is a hazard of burning the CRT phosphor. When initially adjusting the display brightness, I was concerned that the CRT mask (which is attached to the cabinet shell and thus is not in place during adjustment) would significantly reduce display brightness when installed; this proved not to be the case.

Three display formats are available with the H9, switch selected from the keyboard. The usual format is 12 lines of 80 characters. A "short form," of four 12-line columns of 20 characters each, is useful when programming in assembly language or when writing BASIC programs that have short statements. A "plot" mode is also available. In this mode, a single line of text is displayed four times, once on each of the four bottom lines of the screen. The screen area above the bottom four lines is divided into 128 scan lines. A dash, one character wide, will appear above each of the characters displayed in the bottom four lines. The vertical position of the dash is proportional to the binary value of the 7-bit ASCII code for that character. Control characters, as well as standard letters, numbers and punctuation characters, will generate a dash at the appropriate position. In this mode, the cursor movements associated with different control characters do not take place. For example, a RETURN does not generate a return of the cursor but instead causes a dash to appear in the plot 13 lines above that location in the text.

The video terminal will display, and the keyboard will transmit, upper case alphabetic characters only. The display uses a 5x7 dot matrix; the cursor is a non-blinking underline appearing under the next space to be displayed.

The H9 keyboard is a 67-key ASCII keyboard. It contains the standard 52 ASCII keys, five cursor control keys and ten special function/mode keys. Keys are provided to move the cursor up, down, left, right and home. Unlike the others on the H9, these keys are not fully debounced, which is annoying. Additional keys erase the text from the current cursor location to the end of that line; erase all text on the screen and home the cursor; change the display format from 12x80 to 4x12x20 (short form); select whether or not the cursor automatically goes to the begining of the next line after a full line of text is typed; and select whether the display is to be scrolled upward after the first twelve lines of text are displayed. A REPEAT key will repeat the function of another key at a preset rate (3.7-, 7.5-, 15-, or 30-cps; jumper selectable). If the baud rate that has been selected is less than the repeat rate, the repeat function will operate at the slower rate. Additional keys are provided to transmit an entire page, select full or half duplex mode, take the terminal off line, and place the terminal in the PLOT mode.

If the screen has been filled, but the SCROLL key is not pushed in, the cursor will return to the start of the page location and blink. Until the page is erased or the SCROLL key is pushed in, all external inputs are disabled and data can only be transmitted out of the terminal by the keyboard. This feature, when used in conjunction with a paper tape reader/punch, allows program tapes to be reviewed quickly. The reader/punch can read

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the tape at its maximum speed, and after the last line has been written onto the display screen the tape will be stopped automatically. After the operator has reviewed the contents of the screen, pushing the ERASE PAGE key will cause another full page of data to be input automatically.

The terminal has a built-in audible tone generator to take the place of the old Teletype bell.

A baud rate key on the keyboard operates in conjunction with a switch on the rear panel to select the baud rate at which the terminal operates. When the key is pushed in, operation is at the rate set by the switch on the rear panel. This rear panel switch selects either 300 baud or a baud rate preset by an internal jumper. When the keyboard is released, the terminal operates at 110 baud.

The H9 contains a 1Kx8 RAM for storage of the characters to be displayed. This limits the display to the 12x80 format; however, there is room on the H8 RAM board for an additional 1Kx8 of RAM. This indicates that, hopefully, Heath will provide a retrofit in the future to expand the display to a 24x80 format. This would be a useful addition, particularly in word processing applications. A welcome companion modification would be the addition of lower case capability.

The H9 is interfaced to the computer via the terminal's internal serial interface. The H9 I/O circuit board can be wired via jumpers to operate in an RS-232C or TTY (20mA current loop, active or passive) mode. Word lengths of 5-, 6-, 7-, or 8-bit lengths can be jumper selected, as can be a parity bit (odd, even or none).

If a paper tape reader is in use, the reader control is not to be accomplished by connecting the reader to the parallel I/O of the computer, the tape reader can be connected to the H9 and controlled by it.

The connecting terminals on the rear panel of the H9 (and the H8 as well) are unique to Heath, not the 22-pin EIA standard terminals. The H9 is supplied with a very detailed assembly manual and a separate comprehensive operating manual.

COMPARING THE H8 WITH OTHER POPULAR MICROCOMPUTER SYSTEMS

By this point you should have a general idea of what the H8 has to offer. Now let's compare it with other popular microcomputer systems currently on the market.

By necessity, I will only discuss what I feel are the major characteristics of the H8 and its competitors. Some of these will surely seem more important than others to different readers, and I am sure I have left out someone's favorite criterion. Within the limits of my time and expertise, I'll be happy to correspond with anyone concerning any point I've slighted or omitted.

The key word here is "compromise." The H8, like every microcomputer, is indeed a compromise in almost every facet of its design and operation. Perhaps a good deal of the controversy over the H8's departure from the designs of other manufacturers stems from a lack of recognition of this fact. With that in mind, let's analyze the major points of comparison.

THE H8 BUS

As surely every reader knows by now, the H8 uses a 50-line bus. This is incompatible with the S100 bus used in most other 8080A systems. Heath spokesmen have stated that the S100 bus is an older design, has many unnecessary signals, is noisy, has timing problems, and is expensive to implement because of the circuit board edge connectors involved. Rather than get into that controversy, I'd like instead to explore the impact of the H8's unique bus from a practical perspective.

Using a computer with a non-S100 bus means, today, that you are relying heavily on the primary manufacturer. You can't as readily look to secondary sources for special circuit boards, replacement boards if the primary manufacturer isn't around, or lower priced boards which perform the same functions as those supplied by the primary manufacturers. This may mean higher costs (because of the lack of competition), delays in obtaining certain capabilities (because the boards aren't available from any manufacturer), and increased down time (because equivalent boards are not on the market).

In short, before deciding to purchase any non-S100 bus computer, you should look very carefully at the level of support you can expect to obtain for the system. This means support from the marketplace in general — both the primary manufacturer and also present and anticipated second sources.

There are today over half a dozen major non-S100 microcomputer systems on the market. Some have been around longer than others; in the case of the more established ones, we are already seeing a growth in the second-source market availability of circuit boards and peripherals designed to be compatible with these computers. Indeed, at this writing there are already second-source suppliers of both memory boards and CPU/floppy disk units specifically designed to be compatible with the Heath bus. Given Heathkit's size, its tradition of user support, the number of current and projected H8 users and the still-explosive growth of the microcomputer market, there seems little doubt but that the number of second-source suppliers (and the variety of H8 compatible boards and peripherals) will continue to grow. Heath itself is planning to introduce a floppy disk (H17) in June and additional accessory boards later.

Their motto is "We won't let you fail" . . .and they mean it. The service turnaround time I've experienced has been excellent . . .

Whether or not the S100 bus is now or continues to be the "standard of the industry" can be a topic for lively discussion. The point here, however, is whether the H8 bus will be supported by Heath and others. I feel that it already is being adequately supported, and will continue to be.

DOCUMENTATION AND SUPPORT

Heath's well-deserved reputation for superb assembly manuals and documentation has continued with its entry into the microcomputer field.

The assembly manuals carry "step-by-step" instructions to the extreme. If anything, the instructions are so detailed as to invite skipping over the more obvious steps. (This can be a mistake — believe me, there is a reason for Heath's going to the expense and trouble of spelling things out the way they do.) The manuals include schematic diagrams, circuit descriptions, troubleshooting guides, X-ray views and section-by-section test procedures. In addition, you can call Heathkit for help, either at the factory or at one of their over 50 retail sotres, and if it comes to it take the kit back in for diagnosis and repair by Heath technicians. Their motto is "We won't let you fail," and from what I can tell they mean it. The service turnaround time I've experienced has been excellent, and in each case the technician has made sure I understood what the problems were. This level of support is a far cry, regrettably, from that provided by many other microcomputer manufacturers.

Upon opening the H8 carton, the first thing you'll see is a notice: "The H-8 Computer requires a minimum level of programming knowledge and accessory equipment to be fully utilized. Before unpacking and commencing assembly, please review the manuals. If you find the H-8 is not suitable for your purposes at this time, the kit may be returned prepaid for credit or a refund by contacting Heath Company. . ." In other words, Heath has taken the remarkable step of inviting H8 purchasers to carefully analyze the system's assembly, operation and documentation, *after they've bought the kit,* to see if it's what they want. If it's not, they can return it (before it's unpacked and assembled, of course) for a full refund!

Microcomputers are high-technology products. Just because you've built a stereo tuner, and fixed it with a VOM, does not by itself qualify you to build and troubleshoot a unit of this complexity. Your success in building a system, debugging it, putting it to use in your intended applications and deriving any educational benefits in the process are in large part a function of the documentation and support provided by the manufacturer and retailer. In these areas, Heath and its H8 have to be viewed as the benchmark.

COST

A 16K H8/H9/cassette system can be purchased for approximately $1,500, depending upon whether you order by mail or purcahse the system at one of Heath's retail stores. While this does not make the H8 the cheapest microcomputer available, its price does compare favorably with other equivalent systems. A typical savings is $400-$500.

At the moment, Heath accessory cards are somewhat more expensive than equivalent cards available for S100 systems from second-source suppliers; for example, a Heath 8K RAM card currently costs $235 by mail and $250 from a Heath retail store. Again, however, second-source suppliers ar already beginning to undercut these prices; a 12K RAM card is, at this writing, being offered for the same $235 price. This same trend has occurred with respect to other systems, and should become even more pronounced as more small manufacturers begin to make H8 boards available.

HARDWARE

The H8, of course, uses the 8080A CPU. "Newer" microprocessors, such as the Z80, are available, and some commentators have questioned Heath's use of the "older" 8080A.

Rather than depating the merits of one CPU versus another, I will simply point out that these newer CPUs probably will be made available configured for the H8 bus. Indeed, one supplier already offers the Z80 on a card for the H8.

Heath's circuit boards are not particularly dense. As with the 12K RAM board already on the market, we can expect Heath and/or others to make better use of the space available on each circuit card.

RAM address assignments, and most I/O options, are selected by jumpers rather than switches on the H8 and H9 cards. Although this may be less convenient, it is less expensive. As a practical matter, most users will not be changing these jumpers very often if at all. I feel that Heath made the right compromise here between cost and convenience. Why pay for features you're unlikely to use?

One area where Heath may have compromises incorrectly is in the front panel knobs for the H8 and H9. The knobs are blank, and the builder has to attach pregummed paper labels to them. While probably less expensive than supplying knobs which are already marked, this approach results in a less professional appearance.

One minor annoyance when using the Heath-recommended cassette recorder is that the remote motor control cable from the H8 has to be disconnected to allow the cassette to be rewound. Upon completion of a load or dump, the H8 software automatically turns the recorder motor off. This can be remedied by modifying the recorder or cable to install an override switch. Another solution, and the one I use when running in BASIC, is to type in the VERIFY command from the terminal. This reactivates the recorder without destroying the program and allows the tape to be rewound.

All Heathkit software employs "command completion." This feature examines each character as it is typed on the console keyboard. When sufficient information is received . . . the command is . . . completed.

The connecting cable between the H8 and H9 is, if assembled per the Heath manual, only 4 feet long. I haven't tried operating with a longer one, but at the H8/H9 600 baud interface standard a lengthier cable would seem to be feasible.

SOFTWARE

Heathkit supplies without charge a complete software package with the H8. This package consists of the "PAM-8" panel monitor, the "BUG-8" console debugger, the "TED-8" text editor, the "HASK-8" assembly, and the Benton Harbor BASIC. Extended Benton Harbor BASIC is also available at a cost of $10. This software was developed for Heath by the Wintek Corporation.

All Heath software products which use a console terminal include a console terminal driver module which is located in RAM beginning at 040 100 octal. Similarly, all tape handling is accomplished through a common tape handling package. Figures 2 and 3 show the memory and I/O maps for the H8.

All Heath software is supplied on distribution tapes. Each item of software can be user-configured and then dumped, as configured, to a tape which should be used on a day-to-day basis.

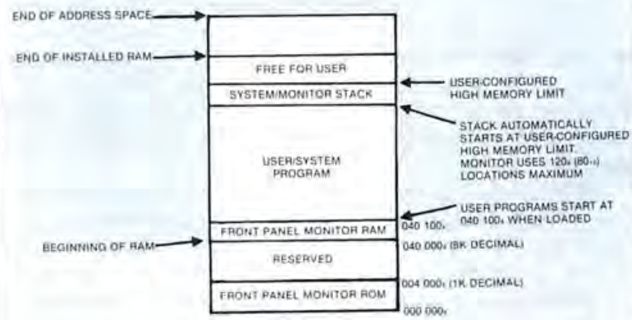

Figure 2. A map of the H8 memory. The high memory limit may be user-configured to coincide with the upper end of installed RAM, or may be set lower to reserve RAM for user-specified applications.

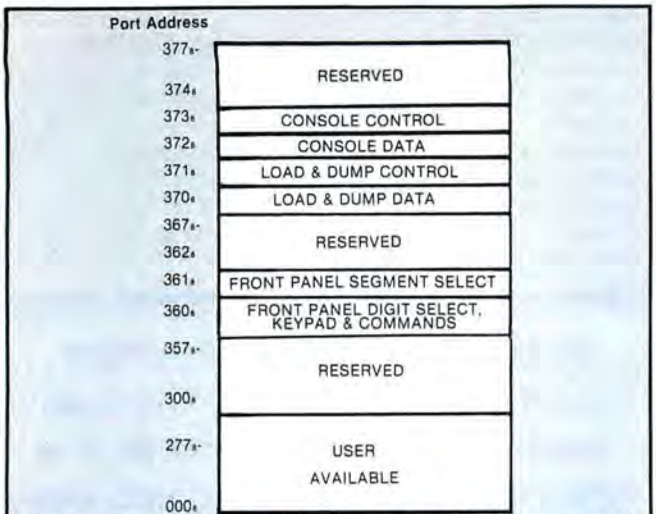

Figure 3. The H8 I/O port map. Ports 000 through 277 (octal) may be utilized by the user as desired.

When a master tape is loaded, the user can configure the software as follows:

1. Determine whether or not a new line is automatically to be generated when the print head or cursor moves past the last column of the terminal.
2. Determine what character (normally CONTROL H, 00008 decimal) generates a backspace.
3. Determine the width of the console terminal as seen by the software, e.g., the maximum number of characters per line.
4. Set the high memory limit. This enables the user to reserve a portion of high memory which won't be used by the software. When you install additional memory in the H8, be sure to reconfigure your software tapes!
5. Determine whether or not the software should input and output lower case letters, e.g., configuring the only software to work with upper/lower case or upper case only terminals.
6. Set the number of nulls which are to be inserted by the software following a carriage return. Slow terminals may require several pad characters; video terminals and many teleprinters will require none.
7. Determine what character (normally 127 decimal) generates a RUBOUT.

Following configuration, a memory image dump to tape of the configured product can be made under terminal control. Software patches are readily inserted by loading a configured or master tape, altering memory contents through the H8 front panel monitor, and then dumping the memory image containing the patches onto a new tape. Heath supplies patches for using an ASR console as the main load/dump port and using a 110-baud console terminal such as a teleprinter (which requires an extra stop bit on the ASCII character sent by the H8).

All Heathkit software employs "command completion." This feature examines each character as it is typed on the console keyboard. When sufficient information is received to uniquely identify one particular command, the command is automatically completed. For example, in BASIC, the letters LOA are sufficient to uniquely identify the command LOAD, and after the A is typed, BASIC supplies the letter D and a trailing space. This is a fine feature for the beginner and also for someone who is intimately familiar with all the commands. For those people, this feature saves time. However, everyone else winds up losing time typing backspaces to correct such statements as LOAD D. Heath does not anticipate issuing patches to disable this feature because it is so embedded in the software.

The PAM-8 panel monitor permanently resides in ROM located in the lower 1024 bytes of memory (000 00 to 004 000 octal). It also uses the first 64 bytes of RAM (040 000 to 040 100 octal). The H8 front panel is assigned I/O ports 360 and 361. PAM-8 contains the fundamental tape loading routines which are used to load all other software. The software manual includes a full listing of the source code for the panel monitor and also the console driver.

Upon power-up, PAM-8 automatically determines the upper limit of continuous RAM (without destroying memory contents) and passes control to the front panel. A program can then be loaded from tape by pressing the LOAD key on the front panel keyboard. When a successful load is completed, a short beep will sound. Program execution then occurs upon pressing the GO key.

The BUG-8 console debugger allows the user to write, load, execute and debug machine language programs in the H8 in octal, decimal or ASCII format working through a separate keyboard/CRT console terminal. The contents of memory locations and the CPU registers can be examined and altered, break points can be set and cleared, programs can be executed (in single steps if desired), and programs can be loaded from and dumped onto magnetic or paper tape. The BUG-8 resides in 3K of RAM, starting at 040 100 octal. The breakpointing feature allows the user to execute several instructions in a program and then return control to the console debugger for analysis and/or modification.

The TED-8 text editor is designed primarily to prepare source code for use by the HASL-8 assembler. However, it can also be used to prepare and edit any textual material such as reports and manuscripts. The TED-8 requires approximately 4K of RAM plus 200 additional bytes of working space. An H8 with 8K of RAM therefore has room for approximately 300 lines of a well-documented program or approximately 175 lines of solid text. A compression technique is used to reduce the amount of buffer used by blanks.

The text editor does not appear to have the capability of processing text in upper and lower case simultaneously. When used with the H8 terminal, this is not a deficiency since the H9 operates in upper case only. However, users with U/L case terminals cannot use the TED-8 as supplied for report writing and word processing. Hopefully, Heath will remedy this deficiency in the future.

The HASL-8 (what a name!) two-pass assembler runs in approximatley 8K of RAM. It assembles the source listings generated by the TED-8 text editor; however, the text editor and assembler are not linked together, and (unlike the case with the H11 software) no linking program is supplied. Therefore, the programmer must often go back and forth from one to the other, which is time-consuming and can be annoying.

Benton Harbor BASIC, and Extended Benton Harbor BASIC, are interpreters requiring 8K and 12K of RAM respectively. Both BASICs accept real and integer numbers and also recognize exponential notation. Integers must lie in the range of 0 to 65535; real numbers must lie in the range of approximately 10^{-38} to 10^{+37}. Both BASICs are internally floating point with approximately 6.9 digits of accuracy. Printout is in decimal form if the number lies in the range 0.1 to 999999; otherwise the exponential form is used. Truncation to six places will occur if necessary. Numbers may be positive or negative. Multiple statements are allowed on one line.

Both BASICs include a "command mode" of operation. This allows entering statements without line numbers, which are executed immediately upon receipt of a carriage return. The command mode allows the H8

to be used as a calculator and provides a simple way to test and debug programs.

Extended Benton Harbor BASIC has a number of additional features:

- Faster Operation
- Character string manipulation
- Subscribed variables and subscripted string variables
- Exponentiation
- Automatic generation of program line numbers
- Single-command deletion of blocks of lines of program statements
- Selective clearing of named variables, arrays or user-defined functions
- Turning the hardware clock on and off (to increase execution speed approximately 11%)
- Controlling the size of a print zone
- Controlling the front panel (LED display)
- Setting up a GOSUB routine which is automatjcally entered upon typing CONTROL-B on the terminal
- Display of amount of free memory and the amount of memory used for text, variables and arrays, FOR loops, GOSUBs, STRINGs, and working space
- Listing of one or a specific group of program lines
- Delaying program execution for a specified length of time
- Returning the maximum or minimum value of a series of expressions
- Returning the tangent of an argument.

Extended Benton Harbor BASIC also generates more explicit error statements and additional error statements pertaining to its unique features.

A new version of Extended B.H. BASIC, which should be available by the time you read this, will include GET, PUT, FLOAD and FDUMP commands. This version will allow the use of separate data files, a most desirable feature.

Both BASICs monitor user spelling. As a command is typed, invalid letter combinations are rejected and a terminal bell is rung.

Although some B.H. BASIC commands are a bit different from most other BASICs, with a little practice these can be anticipated when entering programs written on another machine. The difference I've encountered most often is with the INPUT statement; a response to a string INPUT must be enclosed in quotes. Extended B.H. BASIC offers a LINE INPUT statement which doesn't require this.

Heath's BASICs are not the fastest interpreters on the market, but their speed should be sufficient for most applications. Nor are they compatible with other BASICs, because they employ the PAM-8 monitor subroutines.

Heath supplies an extensive software reference manual in a looseleaf binder. The binder is large enough to insert the operating manuals for the H8 and H9 as well, thus creating a single notebook containing all the reference materials you are likely to need.

Separate sections are included in the software reference manual for the PAM-8, BUG-8, TED-8, HASL-8, and BASIC. Individual tables of contents and indexes accompany each section.

The BASIC section of the manual divides statements into three types — those valid only in the command mode (LOAD, DUMP, RUN, etc.); those valid in either the command or the program mode (CLEAR, DIM, FOR/NEXT, GOSUB/RETURN, GOTO, POKE, etc); and those valid only in the program mode (DATA, INPUT, etc.). Predefined functions (INT, PEEK, RND, etc.) are described separately. An appendix briefly summarizes each statement and function.

The statements and functions are organized alphabetically in the subsections and the appendix, but in both cases the breakdown is into the three different types of statements and then functions. The only complete alphabetical listing of all statements and functions together is contained in the index. As a result, working with the statement POKE and the function PEEK, for example, requires flipping back and forth between a number of different pages.

The software reference manual is intended to be just that. Examples are included, as are cross-references to related instructions. However, as the manual's introduction makes clear, it is not designed to teach you programming. Heathkit has an excellent series of continuing education courses available; as of this writing, they include one on BASIC programming. You should be prepared to look there, or to the multitude of books and magazines published by others in the microcomputer field, to learn computer programming. However, the software reference manual does an excellent job of fulfilling the purpose for which it was designed.

Overall, the Heath software provided with the H8 is well-suited to the needs of the user. Like the 50-line bus, the H8 software is unique to Heath — it cannot be used with other systems and the H8 cannot use software designed for those systems. Thus, software support for the H8 is just as critical as the hardware support factor described earlier. However, my conclusion here is the same as before — the current level of software support is excellent, and should continue to be so.

BUILDING THE H8

Building the H8 is certainly not an overnight project, nor should it be undertaken by a first-time kit builder without some supervision and assistance being available. On the other hand, anyone who has (or is willing to acquire) the ability to solder correctly and who approaches the task with normal amounts of patience and attention to detail can expect to successfully complete the kit.

Building the basic H8 took approximately 14½ hours. Of that time, approximately two hours were spent in checking parts against parts lists and performing the prescribed tests of completed subassemblies. Building each 8K RAM board took two hours, including the time required for parts list checks and board checkout. The serial I/O and cassette interface board required approximately 6½ hours to complete, including one-half hour spend in checking parts and testing and aligning the circuit. The complete computer, including 24K RAM and the serial I/O and cassette interface, therefore required approximately 27 hours to assemble. To borrow a phrase from the car ads, your assembly time may vary based upon your level of experience.

The most important investment you can make to assure success in constructing the H8 — and the H9 also — is a good soldering iron, complete with a stand *which includes a cleaning sponge.* Every ten connections or less, be sure and clean the iron tip — and make this a habit which you follow rigorously. If you don't do this, you'll face the exasperating task of locating and resoldering cold solder joints caused by flux buildup on the iron tip. One bad connection can cause a byte of RAM to function improperly, and the problem may only surface when a program is running at full CPU speed.

You should build the basic H8 first, memory boards (or at least one) next, and then the interface board(s). The checkout procedures for each assume they've been built in this order. If you are also building an H9, it should be constructed before the H8 serial board.

A 65-page assembly manual is included with the basic H8; separate assembly manuals cover the RAM and I/O boards. In typical Heathkit fashion, the manuals are comprehensive and clear. Parts are unpacked from separate packages only as needed, and parts lists are supplied at the beginning of each section of assembly. Pictorial layouts, schematic diagrams and X-ray views are provided, either in the manuals or separately. Not a single part was missing from any of the H8, H9 or accessory board packages — a remarkable record.

The H8 chassis and motherboard are assembled first. The motherboard includes connectors for all ten positions on the bus. Each 50-pin position consists of two 25-pin male plugs. The Heath-recommended procedure, which should be followed here and throughout the kit when installing all plugs, IC sockets and connectors, is to solder one or two pins at each end and then recheck the plug to be sure it's tight against the board and perpendicular to it. It is important to rigorously follow this procedure — unsoldering a 25-pin plug to realign it is, at best, something to avoid!

As the chassis is constructed, the power supply is assembled at the same time. Power supply components not mounted on the chassis are contained on the motherboard.

The left and right cabinet side panels are black plastic. These should be handled with care, as scratching them will remove the black finish. They are mounted via retaining nuts pushed into holes in the panels. Some nuts are mounted flush; others are mounted (using a washer as a guide) extending slightly above the panel surface. If the retaining nuts are not installed precisely as directed, the panels cannot be properly mounted.

The next step is assembling the front panel circuit board. When installing transistors and LEDs, take care to install each lead in the correct hole. Most (but not all) transistors have the emitter, base and collector leads marked on the body. Check that the flat edge of each transistor and LED lamp corresponds with the outline screened on the circuit board.

Disk capacitors should be prepared before inserting them into a board. The leads should be cleaned of in-

sulation with a needle-nose pliers; failure to do so can result in poor (or no) solder connections.

When installing the 16 push button switches, follow a procedure similar to that used with plugs and sockets — position the switch firmly against the board, solder the two pins, and then recheck the alignment and resolder the pins if necessary. After all switches are mounted, knobs are installed. Then, pregummed paper labels are installed on the knobs. Do not attempt to remove a label which has been installed on the wrong knobs; instead, move the knob itself to the correct position. While tedious, care taken here in aligning the switches and installing the labels will pay off in a professional appearance.

Your first exposure to preparing cables and connectors comes at this point. Before soldering the spring connectors to the cable wires, analyze which way — facing up or down — the connectors should be installed. This is best done by matching the cable against the connector shell with the right color wire at the corresponding end of the shell. Spring connectors are then soldered on so that their flat edges will be on the bottom (hole) side of the connector shell when inserted. A large heat sink or a set of spring loaded pliers is very helpful in holding cable wires while soldering on the connectors. Apply solder *very* sparingly — avoid getting solder in the tab or on the spring portion of a connector. If you are building the H9 also, refer to the instructions on page 13 of the H9 manual for a better description of the proper installation procedure and also for a description of how to remove connectors from the shell after they are inserted. If you are building the serial I/O board, look also at page 21 of its manual. It may be easier to hold everything steady if you insert each wire of a cable in the connector shell after its spring connector is attached, rather than soldering all spring connectors on at once.

When installing the 7-segment LED sockets, and later the LEDs themselves, take some time to insure that all nine are aligned parallel. As with the front panel switches, this will enhance the appearance of the completed unit.

When installing ICs, carefully follow the procedure giving for handling the MOS ones. Read the instructions all the way through first and make sure you understand them; failure to follow them can cause destruction of the IC through static electricity.

The CPU board is supplied fully assembled and tested. All that needs to be done is to install it and perform the initial checkout.

Final assembly consists of installing the front panel and some support brackets. I suggest installing the display window, and perhaps the entire front panel, later, after checkout of the H8 with a RAM board installed. This will save removing the panel if any components need to be replaced or wiring errors corrected on the face of the front panel circuit board. Saving the window until after the panel is installed also avoids getting fingerprints on the back of it in the process.

The last step in the assembly manual refers you to the H8 operating manual for the initial test routine. The test routine didn't work — in fact, nothing did! I took the kit back to the local Heathkit store; five days and one red face (mine) later I picked it up. One IC was bad and one LED socket was intermittent; this saved me any service charge. However, the main problem was what is euphemistically called "operator error." Had I analyzed the test routine carefuly, I would have seen that it involves loading data into memory locations. In other words, the routine can't be performed without RAM installed! Once a RAM board was built and inserted, everything was fine.

The end result of the initial test routine is a series of characters on the nine display LEDs. With a little imagination, the message is "YOUR H8 IS UP AND RUNNING (beep beep). I won't tell you how long I let this message repeat itself, or the reactions of other members of my household to this end result of the hours I had spent locked away in my workroom!

H8 ACCESSORY CARDS

As I haven't built the parallel I/O board, I will only discuss construction of the RAM and serial I/O and cassette interface boards.

H8 RAM BOARD

Assembling this board is really nothing more than installing IC sockets, bypass capacitors, sockets connecting the board with the H8 motherboard, and jumpers and miscellaneous components in that order.

When installing sockets connecting the board with the motherboard, follow the same procedure as with other sockets — solder the pins at each end, check alignment, and only then solder the rest.

The basic board comes with ICs and sockets for 4K of RAM. Another 4K (ICs and sockets), available as an accessory kit, may be installed initialy or later. The instructions for the board and the accessory kit are coordinated to cover either alternative.

If the board is your first memory board, it is assigned an address of 8K by a jumper. Otherwise, assignment is

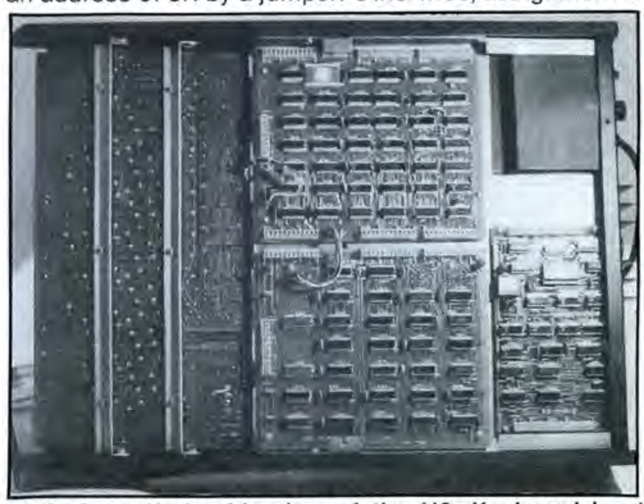

PHOTO 10 Underside view of the H9. Keyboard is at left. TPU board is at center top; RAM and counter board is below it. Character generator board is at bottom right.

at 56K. The manual then directs you to the 8K address memory test routine in the H8 operation manual or the 56K address test routine in the board manual itself. If you follow the board manual test routine, memory is then reassigned to the appropriate address. Since memory must be continuous from 8K up, only one 4K board can be installed, and it must be located at the high end of continuous memory.

H8 SERIAL I/O AND CASSETTE INTERFACE BOARD

By this time, you'll be an old hand at assembling H8 cards. I do suggest that you annotate the manual, either at the beginning or on the appropriate pages, as to which jumper options (audio output level, serial and tape receive and transmit baud rates, one or two tape recorders, and EIA/TTY type signals) you have selected.

The board includes a logic probe circuit for adjusting the PLL and space detector. The logic probe LED can later be used (with the H8 top removed) for monitoring tape input data. I found the PLL adjustment, which is accomplished by rotating the potentiometer until the LED completely stops flickering, to be difficult. It requires a very fine hand on the screwdriver! You might try rotating the pot several times to free up its movement if you have the same problem.

After finding the proper settings of the volume and tone controls on the cassette recorder, you should mark those settings on the controls. It's easy to disturb the settings in the process of connecting and disconnecting the motor control line from the recorder.

If you build this card before your terminal is ready, remember to go back and perform the "terminal test" in the checkout section of the board assembly manual later on.

BUILDING THE H9

Assemblying the H9 took a total of 27 hours, the same amount of time as required for the complete H8 with all

PHOTO 11 The H9 with underside boards removed to show mounting pins. These pass through to wiring harnesses atop the chassis.

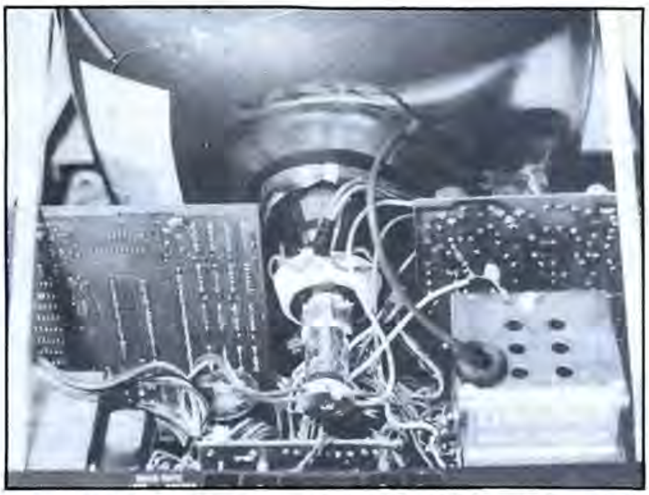

PHOTO 12 Rear top view of the H9. I/O board is at left; video board is at right. Controls for focus, brightness and height are visible at the top of the video board.

its accessory cards. The H9 seemed more involved, perhaps because there is no finished cabinet until the end! On reflection, however, building the H9 is just as straightforward, and no more difficult, than building the H8.

The 140-page assembly manual is accompanied by a multitude of separate sheets of pictorials, X-ray views, schematics, etc. My guess is that this manual was prepared after the one for the H8; it has better instructions and pictorials for such things as assembly of cable connectors. The H9 kit also includes a plastic magnifying glass for finding solder bridges, and a better IC puller. If you're building the H8 and H9, you should use these items for both kits.

The H9 contains separate circuit boards for the power supply, character generator, video circuit, keyboard, RAM and counter, I/O interface and the timing and processing unit. The RAM and counter, TPU and character generator boards are mounted underneath the chassis (Photo 10). These boards plug onto connectors which pass through the chassis (Photo 11) and mate with sockets on the main wiring harnesses. The power supply, video and I/O boards mount above the chassis behind the CRT (Photo 12).

In assembling the chassis, follow the same precautions as with the H8 regarding the black plastic side panels. If you liked preparing the H8 cable connectors, you'll love the H9's! Although considerable work is involved in soldering what seems like an endless number of cable spring connectors, the main cabling is precut and assembled. This significantly reduces point-to-point wiring, which would have been a considerable task.

Construction proceeds through the power supply circuit board, character generator board, video circuit board, keyboard, RAM/counter board and I/O circuit board. The last board is the TPU, and the fact that it is supplied assembled and tested is at that point most welcome.

The H9 keyboard, like the H8 keypad, is assembled by installing switches, then blank knobs, and then pregummed labels on the knobs. You should follow the same precautions as with the H8 regarding switch alignment and label installation. I found a few of the switches to have high resistance or to be intermittent when depressed; these were quickly replaced by the Heath factory.

Some but not all of the circuit boards in my H9 kit were fully solder masked. The circuit board for the keyboard is only etched on the underside. This requires the builder to install a number of jumpers, some of them several inches long, on top of the board. This could have been eliminated by Heath's using a double sided circuit board here, similar to many of the other boards.

In checking out the video circuit board, a problem developed. Instead of 12 lines of 80 characters per the test procedure, my display was of 12x80 solid blocks. After rechecking all boards then installed, upon turning the unit back on there was no video at all.

Upon the advice of local Heath personnel, I went ahead and assembled the rest of the H9 so it could be checked out as a unit. It developed that the horizontal output transistor was shorted, and there were two bad ICs on the I/O board. However — red-faced time again — I had installed two ICs loose and had connected one main harness wire to the wrong pin of a socket. After the unit was repaired by Heath it functioned perfectly.

After two months of use, the H9 CRT display brightness suddenly dropped significantly. This was quickly repaired by Heath at no charge to me. The problem was caused by a leaky capacitor on the video board which resulted in low voltage on grid 2 of the CRT. I was able to have the terminal repaired while I waited at the local Heath store — you couldn't ask for better service.

SUMMARY

If you want to build your computer yourself, in my opinion Heath must be the standard against which to measure. Although considerable time was involved, I found assembling the H8 and H9 to be straightforward, relatively simple and really enjoyable. After 54 hours of work and over 6,000 solder connections, I had a complete, fully operational, professional-looking computer system which I could say I built myself. (That impresses neighbors no end; don't let them know how simple it really is with instruction manuals of this calibre.)

I am completely satisfied, and indeed delighted, with my H8 system. It does everything Heath says it will, and does it very well. Anyone in the market for a microcomputer should give careful consideration to the H8; it represents a very well thought out approach, from beginning to end.

A 24-Line Display for the Heath H9

By Stephen L. Sama

The Heath H9 video terminal is a very versatile instrument with an abundance of operating modes and interface features. However, many H9 owners have probably shared my frustration with the rather limited 12-line display format. Only relatively small portions of a program can be displayed for editing, and graphical outputs can only be inspected with 12 point resolution. This article is intended to be a reference for present and future owners of an H9, describing my conversion scheme for doubling the display capacity of this terminal.

At the outset I was briefly encouraged by the fact that there were provisions on the RAM and counter circuit board of the terminal to exactly double the display memory size. I was hopeful that Heath had planned a future expansion to 24-line format. However, on communication with the factory I learned that these extra RAM locations were only remnants of an abandoned idea for a two-page feature.

As it turns out, though, the convenience of these extra RAM locations combined with the fact that the H9 display is in reality a 24-line type with 12 lines purposely blanked, made conversion of the terminal to 24-line output a practical venture.

THE CONVERSION

The conversion circuitry I present here turns the H9 terminal into a 24 line by 80 character format display device. All original features are retained, including proper scrolling, erasing, homing, plot mode with the first line displayed 8 times, and short form display in four columns of 24 lines each. Only the appearance of the cursor was significantly modified. The new cursor is an enhanced square the size of one character location. When the cursor is placed over a displayed character, the character is still visible at about twice the intensity of the cursor. All original cursor motions and modes are preserved.

For about $40 invested in parts, of which $30 is used to buy two 2114 memory chips, a complete conversion can be implemented. Six standard TTL chips must also

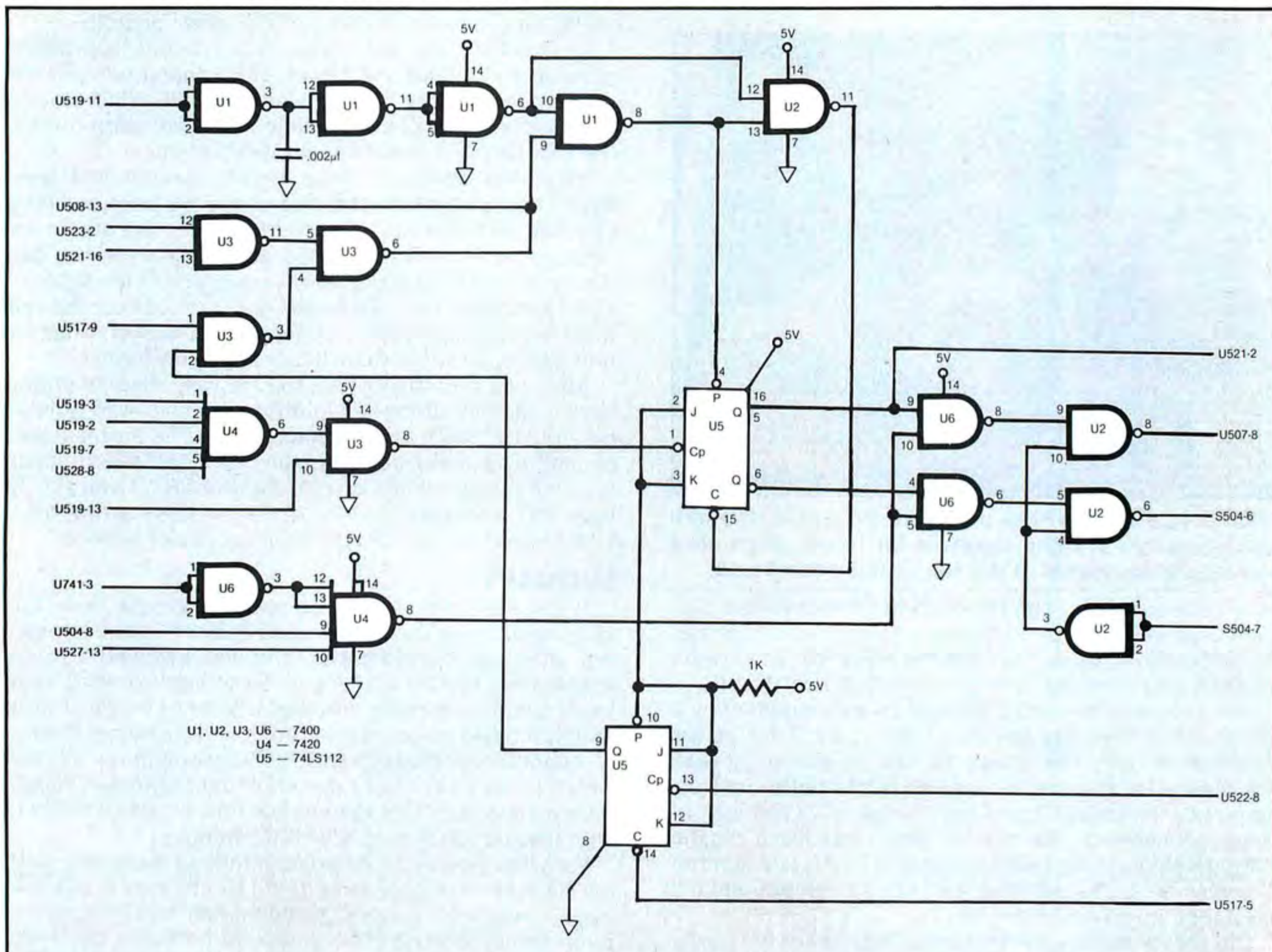

Figure 1.

be added on a separate breadboard with most interconnections made to the RAM and counter circuit board. I recommend mounting this board on the keyboard support brackets alongside the RAM and counter board. Layout and lead length are not critical and almost any breadboarding technique should work.

The following is a listing of changes which must be made to the H9 PC boards themselves. The terms "cut" and "jump" are obvious in definition. "Isolate" means that a given point or section of a chip must be disconnected from the circuit by land-cutting, but the original continuity of all connections must not otherwise be disturbed. Designations are of the form XYYY-Z where X is U for an IC package and X is S for a PC board connector. YYY is the package or connector number and Z is the corresponding pin number. The most significant digit of YYY identifies the proper PC board in accordance with the conventions of the Heath schematics (i.e. 7 for the TPU board, 5 for the RAM and counter board and 2 for the character generator board):

CHARACTER GENERATOR BOARD MODIFICATIONS

1. Cut S202-3 to U213-7
   Jump S202-3 to U213-6

2. Isolate U222-9, U222-11
   Jump U222-9 to U212-6
   Jump U222-11 to U212-4

3. Cut U219-4 to U218-5
   Isolate U221-4, U221-5, U221-6
   Jump U218-10 to U219-10
   Jump U221-2 to U219-11
   Jump U221-4 to U218-5
   Jump U221-5 to U219-4
   Jump U221-6 to U210-3

RAM AND COUNTER BOARD MODIFICATIONS

1. Jump U508-11 to U520-3
   Jump U521-2 to U508-12
   Isolate S504-7

2. Jump S504-8 to U504-9,10
   Jump S501-5 to U527-11,12

Figure 1 shows the schematic of the required external breadboard. I recommend that a standard speed TTL device be used for U1. The circuit should work with any speed version for the remaining chips. The type and tolerance of the .002μf capacitor is not critical. With one exception, all connections are made to the RAM and counter circuit board. I suggest tapping power from the RAM and counter circuit board as well.

The major undertaking in this project is that of the 22 interconnection wires. Pay careful attention here to avoid errors by using color coded wires, preferably from ribbon cable. I also advise preparation of your own wire-run list for both checkout and your own future reference. Do not forget to add the two additional 2114 memory chips and their sockets into the vacant locations on the RAM and counter PC board.

I feel that anyone who was successful in assembling a project of the magnitude of the H9 terminal kit should have no trouble incorporating this 24 line conversion. But I must emphasize the need for careful assembly, neatness (to make errors more apparent) and plenty of circuit doublechecking before turning the power on. The H9 terminal is a complex system. Trusting your trouble-shooting skills instead of completely checking out your wiring can result in tremendous amounts of wasted time.

Try the conversion; the added power and convenience of the expanded display is well worth the effort.□

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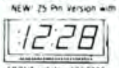

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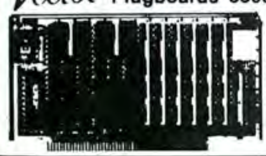

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9	DE-9S	2.15	
15	DA-15P	2.11	1.50
15	DA-15S	3.10	
25	DB-25P	3.00	1.50
25	DB-25S	4.00	
37	DE-37P	4.14	2.00
37	DE-37S	6.00	
50	DD-50P	5.40	2.25
50	DD-50S	8.00	

EDGE CONNECTORS

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44	DUAL	22 PIN	GOLD	1.95
44	DUAL	22 PIN	GOLD	2.50
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86	DUAL	43 PIN	GOLD(6800)	5.00
100	DUAL	50 PIN	GOLD(IMSAI/ALTAIR)	4.25
100	DUAL	50 PIN	GOLD(IMSAI/ALTAIR)	4.95
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16	36	34	32	30
18	70	60	54	40
20	88	75	67	55
22	95	80	72	59
24	95	80	72	59
28	95	84	80	71
36	1.40	1.25	1.08	83
40	1.56	1.40	1.20	89

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(14)	25	20	16	14
(16)	25	20	18	16
(18)	28	27	26	20
(20)	34	33	30	239
(22)	36	35	34	28
(24)	36	35	34	289
(28)	44	43	42	367
(40)	60	58	57	493

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7403	.20	7445	1.05	74107	.40	74163	1.40
7404	.20	7446	1.05	74109	.45	74164	1.50
7405	.25	7447	.85	74110	.80	74165	1.40
7406	.35	7448	.95	74116	2.00	74166	1.50
7407	.35	7450	.20	74120	1.25	74167	3.00
7408	.25	7451	.20	74121	.55	74170	2.00
7409	.25	7453	.20	74122	.45	74172	9.75
7410	.20	7454	.20	74123	.95	74173	1.50
7411	.25	7460	.20	74125	.55	74174	1.10
7412	.40	7470	.40	74126	.60	74175	1.20
7413	.75	7472	.35	74128	.65	74176	1.50
7416	.35	7473	.40	74132	1.50	74177	.90
7417	.40	7474	.40	74136	1.80	74180	1.00
7420	.20	7475	.70	74141	1.15	74181	2.00
7422	.75	7476	.40	74142	4.00	74182	.90
7425	.35	7479	2.00	74144	4.00	74184	2.00
7426	.30	7480	.69	74145	1.10	74185	2.00
7427	.35	7482	1.50	74147	2.50	74186	12.00
7428	.40	7483	.85	74148	1.75	74190	1.40
7429	.40	7485	1.10	74150	1.00	74191	1.25
7430	.25	7486	.40	74151	1.10	74192	1.10
7432	.30	7489	2.25	74153	1.10	74193	1.10
7433	.40	7490	.55	74154	1.10	74194	1.20
7437	.30	7491	1.10	74155	1.10	74195	1.00
7438	.35	7492	.60	74156	1.10	74196	1.10
7439	.36	7493	.60	74157	1.20	74197	1.30
7440	.20	7494	.85	74158	1.75	74198	1.50
		7495	.90	74159	3.60	74199	1.75

74LS00

74LS00	.29	74LS60	.29	74LS138	1.25	74LS192	2.25
74LS01	.29	74LS73	.49	74LS139	1.25	74LS193	2.25
74LS02	.29	74LS74	.49	74LS151	1.25	74LS194	1.89
74LS03	.29	74LS75	.69	74LS153	1.25	74LS195	1.87
74LS04	.29	74LS76	.49	74LS154	3.65	74LS196	1.87
74LS05	.35	74LS78	.65	74LS155	1.25	74LS197	1.87
74LS08	.29	74LS83AN	1.75	74LS156	1.85	74LS221	2.00
74LS10	.29	74LS85	2.25	74LS157	1.50	74LS240	3.00
74LS11	.40	74LS86	.69	74LS158	1.55	74LS241	3.00
74LS12	.50	74LS90	.89	74LS160	1.95	74LS242	3.00
74LS13	.69	74LS92	.89	74LS161	1.95	74LS243	2.60
74LS14	1.70	74LS93	.89	74LS162	1.95	74LS244	2.60
74LS15	.40	74LS95	1.50	74LS163	1.95	74LS247	1.68
74LS20	.29	74LS96	1.89	74LS164	1.95	74LS248	1.35
74LS21	.40	74LS107	.55	74LS165	2.00	74LS251	1.91
74LS22	.40	74LS109	.59	74LS166	2.00	74LS253	1.75
74LS26	.39	74LS112	.59	74LS168	2.00	74LS257	1.75
74LS27	.39	74LS113	.60	74LS169	2.00	74LS258	1.95
74LS28	.39	74LS114	.60	74LS170	4.00	74LS259	4.25
74LS30	.29	74LS122	.60	74LS173	2.00	74LS260	.50
74LS32	.39	74LS123	1.25	74LS174	1.87	74LS266	.68
74LS37	.48	74LS124	1.80	74LS175	1.95	74LS273	2.50
74LS38	.48	74LS125	.87	74LS181	3.69	74LS279	.79
74LS40	.39	74LS126	1.07	74LS189	6.16	74LS283	1.85
74LS42	1.20	74LS132	1.25	74LS190	2.49	74LS289	6.16
74LS47	1.25	74LS136	.59	74LS191	2.49	74LS290	1.56
74LS48	1.68					74LS293	1.56
74LS51	.29					74LS295	2.00
74LS52	.29					74LS298	2.00
74LS54	.29					74LS352	1.65
74LS55	.29					74LS367	.87
						74LS390	3.00
						74LS670	3.95

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34001	.40	4050	.61	4517	8.50	MM74C173N	1.39
4000	.25	4051	1.10	4518	1.65	MM74C174N	1.39
4001	.25	4052	1.10	4519	.90	MM74C175N	1.39
4002	.25	4053	1.10	4520	1.65	MM74C192N	1.71
4004	3.50	4060	3.25	4521	3.25	MM74C193N	1.71
4006	1.40	4061	7.00	4522	1.75	MM74C195N	1.61
4007	.25	4063	2.50	4527	3.00	MM74C200N	10.45
4008	1.25	4066	.85	4528	1.75	MM74C221N	2.13
4009	.48	4067	6.00	4583	1.45	MM74C901N	.84
4010	.48	4068	.35	4584	.75	MM74C902N	.84
4011	.25	4069	.35	MM74C00N	.38	MM74C903N	.84
4012	.25	4070	.85	MM74C02N	.38	MM74C905N	11.20
4013	.60	4071	.35	MM74C04N	.38	MM74C906N	.84
4014	1.25	4072	.35	MM74C08N	.38	MM74C907N	.84
4015	1.25	4073	.35	MM74C10N	.38	MM74C908N	3.80
4016	.59	4075	.35	MM74C14N	2.18	MM74C909N	2.52
4017	1.25	4076	1.85	MM74C20N	.38	MM74C910N	10.45
4018	1.25	4077	.42	MM74C30N	.38	MM74C914N	2.18
4019	.70	4078	.35	MM74C32N	.38	MM74C915N	1.71
4020	1.25	4081	.35	MM74C42N	1.42	MM74C918N	4.19
4021	1.75	4082	.35	MM74C48N	2.13	MM74C922N	5.65
4022	1.25	4085	1.35	MM74C73N	.84	MM74C923N	5.75
4023	.35	4086	1.45	MM74C74N	.67	MM74C925N	12.00
4024	1.00	4089	3.00	MM74C76N	.84	MM74C926N	12.00
4025	.35	4093	1.75	MM74C83N	2.00	MM74C927N	12.00
4026	2.25	4098	2.50	MM74C85N	2.00	MM74C928N	12.00
4027	.60	4160	1.75	MM74C86N	.99	MM80C97N	.84
4028	1.25	4161	1.75	MM74C89N	6.75	MM80C98N	.84
4029	1.50	4162	1.75	MM74C90N	1.32		
4030	.60	4163	1.75	MM74C93N	1.32		
4032	1.60	4174	1.75	MM74C95N	1.61		
4033	2.00	4175	1.60	MM74C107N	1.89		
4034	3.50	4194	1.80	MM74C150N	5.67		
4035	1.60	4501	.38	MM74C151N	3.80		
4038	1.60	4502	1.75	MM74C154N	5.67		
4040	1.50	4503	1.15	MM74C157N	3.40		
4041	1.45	4506	.70	MM74C160N	1.71		
4042	1.25	4507	1.00	MM74C161N	1.71		
4043	1.20	4508	4.00	MM74C162N	2.57		
4044	1.25	4510	1.75	MM74C163N	1.71		
4045	2.50	4511	2.00	MM74C164N	1.61		
4046	1.95	4512	1.50	MM74C165N	1.61		
4047	2.50	4514	4.75				
4048	1.00	4515	4.75				
4049	.61	4516	1.75				

LINEAR

LM300H	1.70	LM702H	.79	LM2111N	1.35
LM301AH	.35	LM703LN	.45	LM2900N	.90
LM301AN	.35	LM703CH	.45	LM2901N	2.95
LM302H	.75	LM709CH	.40	LM2902N	3.00
LM306H	2.50	LM710CH	.60	LM2903N	1.60
LM307H	.55	LM710N	.75	LM2904N	1.60
LM307N	.35	LM711CH	.39	LM2917N	2.00
LM308AH	3.25	LM711CN	.39	LM3046N	1.25
LM308AN	3.00	LM723CH	.55	LM3053N	1.50
LM308H	1.00	LM723CN	.55	LM3064N	1.25
LM308N	1.00	LM725CH	2.50	LM3065N	1.00
LM310H	1.15	LM725CN	3.00	LM3067N	2.60
LM310N	2.00	LM733CH	1.00	LM3075N	1.75
LM311D	2.00	LM733CN	1.00	LM3089N	3.00
LM311H	.90	LM739N	1.19	LM3146N	2.00
LM311N	.80	LM741CH	.35	LM3302N	2.00
LM311N	.80	LM741CN	.35	LM3401N	.80
LM312H	2.70	LM741CJ	.39	LM3900N	.49
LM318H	1.50	LM741CN	.39	LM3905N	.89
LM318N	1.50	LM747CH	.79	LM3909N	.90
LM319N	1.25	LM747CN	.79	LM3911N	1.25
LM321H	3.00	LM748CH	.39	LM4024N	2.75
LM322N	3.00	LM748CN	.39	LM4044N	3.00
LM324N	1.65	LM760CN	3.00	LM4250CH	2.00
LM339AN	3.00	LM1303N	.90	LM4250CN	2.00
LM339N	.99	LM1304N	1.19	LM4558N	.75
LM348N	1.85	LM1305N	1.40	LM5556N	1.75
LM350N	1.00	LM1307N	.85	LM5558N	1.00
LM358N	1.00	LM1310N	2.25		
LM370H	1.15	LM1358N	1.00		
LM370N	2.75	LM1414N	1.75		
LM373N	2.95	LM1458H	1.30		
LM375N	3.00	LM1458N	.59		
LM377N	2.00	LM1468N	2.90		
LM380N	1.05	LM1488N	1.95		
LM380N	1.05	LM1489N	1.95		
LM380N	1.05	LM1496H	.95		
LM381N	1.75	LM1496N	.95		
LM382N	1.75	LM1556N	1.75		
LM386H	.85	LM1596J	2.25		
LM387AN	.75	LM1800N	1.90		
LM387N	.95	LM1808N	2.00		
LM388N	1.25	LM1810N	2.00		
LM389N	1.25	LM1812N	4.00		
NE531T/V	2.00	LM1820N	1.25		
NE550A	1.30	LM1830N	2.00		
NE555V	.39	LM1845N	1.75		
NE556B	1.25				
NE560B	5.00				
NE562B	5.00				
NE565B	1.50				
NE566B	2.00				
NE566T/V	1.75				
NE567V	1.59				

RCA LINEAR SERIES

CA3013	2.15
CA3023	2.56
CA3035	2.48
CA3039	1.35
CA3046	1.30
CA3059	3.25
CA3060	3.25
CA3080	.85
CA3081	2.00
CA3082	2.00
CA3083	1.60
CA3086	.85
CA3089	3.75
CA3130	1.39
CA3140	1.75
CA3401	.49
CA3600	3.50

MICROPROCESSOR CRYSTALS

FREQUENCY	price
1.0 MHz	5.95
1.8432 MHz	9.80
2.0 MHz	5.95
2.097152 MHz	8.50
2.4576 MHz	8.50
2.667 MHz	8.50
3.00 MHz	8.50
3.20 MHz	8.50
3.2768 MHz	8.50
3.579545 MHz	1.25
4.0 MHz	4.95
4.0 MHz	4.95
4.194304 MHz	4.95
4.91520 MHz	4.95

FREQUENCY	price
5.0 MHz	4.95
5.0688 MHz	4.95
5.185 MHz	4.95
5.7143 MHz	4.95
6.00 MHz	4.95
6.144 MHz	4.95
6.40 MHz	4.95
6.5536 MHz	4.95
8.0 MHz	4.95
10.0 MHz	4.95
18.00 MHz	4.95
18.432 MHz	4.95
20.0 MHz	4.95
22.1184 MHz	4.95
27.0 MHz	4.95
36.0 MHz	4.95
48.0 MHz	4.95

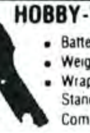
FOR PROCESSOR TECH
14.318 $4.95

DIP SWITCHES

4 POSITION	$1.50	7 POSITION	1.80
5 POSITION	1.60	8 POSITION	2.00
6 POSITION	1.70	9 POSITION	2.25
		10 POSITION	2.50

WIRE WRAP CENTER

HOBBY-WRAP TOOL-BW-630



- Battery Operated (Size C)
- Weighs ONLY 11 Ounces
- Wraps 30 AWG Wire onto Standard DIP Sockets (.025 inch)
- Complete with built-in bit and sleeve

$34.95 batteries not included

WIRE-WRAP KIT — WK-2-W

WRAP • STRIP • UNWRAP

- Tool for 30 AWG Wire
- Roll of 50 Ft White or Blue 30 AWG Wire
- 50 pcs each 1", 2", 3", & 4" lengths — pre-stripped wire

$11.95

WIRE WRAP TOOL WSU-30

WRAP • STRIP • UNWRAP - $5.95

WIRE WRAP WIRE — 30 AWG

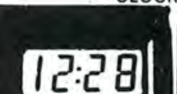
50 ft $1.95 1000 ft $15.00

SPECIFY COLOR — White - Yellow - Red - Green - Blue - Black

WIRE DISPENSER — WD-30

- 50 ft roll 30 AWG KYNAR wire wrap wire **$3.45 ea.**
- Cuts wire to desired length
- Strips 1" of insulation **Specify** — Blue-Yellow-White-Red

LIQUID CRYSTAL DIGITAL CLOCK-CALENDAR

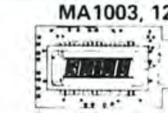


For Auto, Home, Office
Small in size (2x2½x½)
Push button for seconds release for date.
Clocks mount anywhere with either 3M double-sided tape or VELCRO included
2 MODELS AVAILABLE
LCD-101 portable model runs on self-contained batteries for better than a year
LCD-102 runs on 12 volt system and is back-lighted

LCD-101 or LCD-102 your choice .... **$33.95 ea**

Clear desk stand for **$2.00**

MA1003, 12V DC CLOCK MODULE



Built in X'TAL controlled time base. Protected against automotive volt transients. Automatic brightness control with 0.3" green color display. Display turnoff with ignition "OFF"

$17.95

JADE

Computer Products

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(213) 679-3313

RETAIL STORE HOURS M-F 9-7 SAT. 9-5

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1978 CATALOG NOW AVAILABLE

JADE

FOR ALL CUSTOMERS EXCEPT CALIF. CALL TOLL FREE 800-421-5809

21L02 (450ns) Static Rams 100 @ $1.10 ea.	1702A E–PROM 8 @ $3.75 ea.	6502 Microprocessor 5 @ $11.00 ea.	2708 (450ns) E–PROM 8 @ $11.00 ea.	21L02 (250ns) Static Rams 100 @ $1.36 ea.	Z–80A Microprocessor 5 @ $25.00 ea.	8212 8 Bit I/O Port 25 @ $3.00 ea.	4116 (200ns) 16K Dyn. Ram 16 @ $24.00 ea.
Z-80 Microprocessor 5 @ $20.00 ea.	8224-4 Clk.Gen.&Dvr. 25 @ $8.75ea.	410D (200ns) Static Ram 100 @ $8.75ea.	4096 Dynamic Ram 100 @ $3.50 ea.	4200A (200ns) Static Rams 25 @ $10.00 ea.	74LS367 Hex Buffer 100 @ .70¢ ea.	74LS368 Hex Inverter 100 @ .70¢ ea.	2513 (5v) Character Gen. 5 @ $9.00 ea.

MICROCOMPUTER COMPONENTS

MICROPROCESSOR'S

F8	16.95
Z80	22.00
Z80A	28.00
CDP1802CD	19.95
2650	24.95
AM2901	22.95
6502	11.95
6800	18.95
6802	25.00
8008-1	9.95
8035	22.00
8080A	11.95
8085	27.00
TMS9900TL	75.00

8080A SUPPORT DEVICES

8212	3.50
8214	9.00
8216	3.75
8224	3.50
8224-4	9.95
8226	3.95
8228	7.95
8238	7.50
8251	9.95
8253	21.95
8255	21.95
8257	21.95
8259	21.95
8275	75.00
8279	20.00

FLOPPY DISC CONTROLLER

1771B	55.95
1771B-01	57.95

KEYBOARD CHIPS

AY5-2376	13.75
AY5-3600	13.75

PROM'S

1702A	4.00
2704	15.00
2708	12.00
2716	30.00
2716 Intl	38.00
2758	26.60
D3601	4.50
D3604	13.00
5203AQ	5.00
5204AQ	7.50
6834	17.50
6834-1	14.95
82S23B	4.00
82S129B	4.25
8223B	3.50

6800 SUPPORT

6810P	4.95
68B10P	6.00
6820P	7.50
6821P	7.50
6828P	11.25
6834P	16.95
6850P	9.75
6852P	11.75
6860P	10.00
6862P	14.50
6871P	28.00
6875P	8.75
6880P	2.50

Z80 SUPPORT DEVICES

3881	12.95
3882	12.95

STATIC RAMS

21L02	1.50	1.24	1.18
21L02 (350)	1.60	1.35	1.25
21L02 (250)	1.75	1.60	1.50
410D	10.75	10.00	9.25
1101A	1.00	.90	.80
2101-1	2.95	2.75	2.60
2102	1.25	1.15	1.00
2111-1	3.95	3.50	3.25
2112-1	2.95	2.80	2.69
2114-3	11.00	10.00	9.25
2125L	11.10	9.00	8.30
2147	37.50		
31L01	2.50	2.35	2.00
3106	3.95	3.70	3.25
3107	3.95	3.70	3.25
TMS-4044	9.95	9.00	8.95
4200A	12.95		
TMS-4045	11.00	10.00	9.25
5101	8.30	7.40	7.25
74C89	3.25	3.05	2.65
7489	2.25	2.10	1.90
74S201	4.50	4.00	3.75
P8101	4.20	3.40	2.80
P8155	17.00	14.00	
P8156	21.00	18.00	
8599	1.88	1.75	1.60
9102BPC	1.65	1.45	1.30

CHARACTER GENERATORS

2513	6.75
2513 5v upper	9.75
2513 5v lower	10.95
2516	10.95
MCM6571	10.95
MCM6571A	10.95
MCM6574	13.25
MCM6575	13.25

WAVEFORM GENERATOR

8038	3.50
MC4024	2.25
566	1.50

DYNAMIC RAMS

416D/4116	32.00
1103	1.00
2104	4.00
2107B	4.25
2107B-4	3.95
TMS4050	4.00
TMS4060	4.50
TMS4070-2	32.00
4096	4.00
4116/416D	32.00
MM5270	4.50
MCM6605	5.00

USRT

S2350	10.75

UART'S

AY5-1013A	5.25
AY5-1014A	8.25
TR1602B	5.25
TMS6011	5.95
IM6402	10.80
IM6403	10.80

MISC. OTHER COMPONENTS

N8T20	3.39
N8T26	2.10
N8T95	1.35
N8T96	1.35
N8T97	1.35
N8T98	1.35
81LS95	2.00
81LS97	2.00
1488	1.75
1489	1.75
D3205	4.00
D3207A	4.55
D3208A	14.20
D3211	10.00
B3222	9.75
B3242	10.15
D3245	5.60
C3404	6.75
P3408A	12.00
P4201A	5.20
MM5320	7.50
MM5369	1.90
TMS5501	24.95
DM8130	2.90
DM8131	2.75
DM8833	2.50
DM8835	2.50
DM8837	1.75
MK50240	20.00
MK50250	15.00

JADE 8080A KIT

$100.00 KIT

BARE BOARD $30.00

E–PROM BOARDS

MR 8 (8K uses 2708) with 1K RAM	KIT	$99.50
MR 16T (16K uses 2716) with 1K RAM	KIT	$99.50
MM 16 (16K uses 2708)		$99.00
RAM-N-ROM (16K uses ... E PROM)	KIT	$117.00
JG 8/16 (uses 2708 or 2716)	KIT	$59.95
BARE BOARD		$30.00

TU-1

Convert T.V. set to Video Monitor.

KIT $8.95

STATIC RAM BOARDS

8K

250ns	ASSEMBLED & TESTED	$189.95
450ns	ASSEMBLED & TESTED	$149.75
250ns	KIT	$169.95
450ns	KIT	$125.00
	BARE BOARD	25.00

6800 ADAPTER to S-100 System KIT $12.95

16K

250ns	ASSEMBLED & TESTED	$435.00
450ns	ASSEMBLED & TESTED	$380.00
450ns	KIT	$335.00

32K

250ns	ASSEMBLED & TESTED	$850.00
450ns	ASSEMBLED & TESTED	$775.00
450ns	KIT	$675.00

DYNAMIC RAM BOARDS

On board Refresh power is provided with no wait states or cycle stealing required.
+8VDC 400MA DC, +18VDC 400MA DC and 18VDC 30MA DC

EXPANDABLE 32K

8K (375ns)	KIT	$151.00
16K (375ns)	KIT	$259.00
24K (375ns)	KIT	$367.00
32K (375ns)	KIT	$425.00

EXPANDABLE 64K

16K (375ns)	KIT	$281.00
32K (375ns)	KIT	$519.00
48K (375ns)	KIT	$757.00
64K (375ns)	KIT	$995.00

MOTHER BOARD's – S-100 Style

13 slot – w/front panel slot

BARE BOARD $35.00

KIT $95.00

22 slot $149.95

ASSEMBLED & TESTED

THE PROM SETTER

WRITE & READ
EPROM
1702A – 2708 – 2716
5204 – 6834

- Plugs directly into your ALTAIR IMSAI Computer
- Includes Main Module Board and External EPROM Socket Unit
- The EPROM Socket Unit is connected to the Computer through a 25 pin connector
- Programming is accomplished by the Computer
- Just read in the Program to be Written on the EPROM into your Processor and let the Computer do the rest
- Use Socket Unit to Read EPROM's Contents into your Computer
- Software included
- No external power supplies. Your computer does it all
- Doubles as an Eight Bit Parallel I/O
- Manual included

KIT $210.00

ASSEMBLED $375.00

KIM–1

ASSEMBLED & TESTED $245.00

MEMORY PLUS

for KIM–1

8K RAM (21L02)

8K EPROM

ASSEMBLED & TESTED

$245.00

JADE Z80 KIT

—with PROVISIONS for ONBOARD 2708 and POWER ON JUMP

$135.00 EA. (2MHZ)

$149.95 EA. (4MHZ)

BARE BOARD $35.00

JADE Z80 "UPGRADE" KIT

Change your JADE 2MHz Z80 to a 4MHz version with this simple kit:

only $17.95 with trade

$49.95 purchase.

To trade, you must give us your 2MHz Z80 chip and 8224 clock driver.

The "UPGRADE KIT" includes:

Z80A chip, 1 8K resistor
8224-4 clock driver 20 pf. capacitor
36MHz crystal

COMPU/TIME CT 100

S100 BUS COMPATIBLE

TIME & CALENDAR

Microprocessors need the power that a real time clock can offer. Date and time becomes instantly available. **COMPU/TIME** does not have to be initialized every time the system is powered up. It possesses a crystal-controlled time base to obtain superior accuracy and has two setable coincidence counters. Time, date, and counters are set via software.

COMPUTATIONAL FUNCTION

Microprocessors need to be complimented by hardware arithmetics to free up memory pages dedicated to floating point routines and mathmatical software. **COMPU/TIME** provides a 40 function calculator array so that algebraic, trigonometric, basic arthmetic problems can be solved without the need of developing sophisticated software.

Buy It Your Way

COMPU/TIME	CT100	$199	KIT	$245	Assembled
COMPU only	C101	$149	KIT	$189	Assembled
TIME only	T101	$165	KIT	$205	Assembled
COMPU/TIME	PC Board only	$80			

JADE VIDEO INTERFACE KIT

FEATURES $99.95

S-100 Bus Compatible
32 or 64 Characters per line
16 lines
Graphics (128 x 48 matrix)
Parallel & Compositive video
On board low-power memory

Powerful software included for cursor, home, EOL, Scroll Graphics/Character, etc.
Upper case, lower case & Greek
Black-on-white & white-on-black

full ASCII PROFESSIONAL KEYBOARDS

Full 128 Character ASCII!
Tri-Mode MOS Encoding!
MOS DTL TTL Compatable Output!
Two-key Rollover!
Level and Pulse Strobe!
Shift and Alpha Lock!
Selectable Parity!
Positive or Negative Logic!

MODEL 756 (56 keys)

PRICING INFORMATION

Model 756 (assembled)	$75.95
Model 756K (kit)	64.95
Model 702 Enclosure	29.95
Model 710 Numeric Pad	9.95
Model 756MF Mtg. Frame	8.95

CONNECTORS

DB – 25P	$3.00
DB – 25S	$4.00
COVER	$1.50
44 Pin – PC & EYE	$1.95
44 Pin – WW	$2.50
86 Pin – (6800) PC	$5.00
86 Pin – (COSMAC ELF) PC	$5.00
100 Pin – (Altair) PC	$4.50
100 Pin – (Imsai) PC	$3.75
100 Pin – (Imsai) WW	$4.25

JADE REAL TIME CLOCK FOR S-100 BUS

1 MHZ Crystal Oscillator
Two independent interrupts
One interrupt uses 16 bit counter in 10 USEC steps
Other interrupt is in decade steps from 100 USEC to 10 sec.
Both software programmable
Board can be selected by 128 device code pairs.
Complete documentation includes software to display time of day.
Double sided solder mask
Silk screen parts layout

JG-RT ASSEMBLED & TESTED	$179.95
JG-RT KIT	$124.95
BARE BOARD with Manual	$30.00

TARBELL CASSETTE INTERFACE

- Plugs directly into your IMSAI or ALTAIR*
- Fastest transfer rate: 187 (standard) to 540 bytes/second
- Extremely Reliable – Phase encoded (self-clocking)
- 4 Extra Status Lines, 4 Extra Control Lines
- 37-page manual included
- Device Code Selectable by DIP-switch
- Capable of Generating Kansas City tapes also
- No modification required on audio cassette recorder

JADE KIT* $99.95 ASSEMBLED $175.00

*16 month warranty from JADE) MANUAL $4.00

JADE PARALLEL/SERIAL INTERFACE KIT

S-100 $124.95 KIT

2 Serial Interfaces with RS232 interfaces or 1 Kansas City cassette interface.
Serial interfaces are crystal controlled.
Selectable baud rates.
Cassette works up to 1200 baud.
1 parallel port.

DATA COMMUNICATIONS ADAPTER

80-103A Serial I/O and FSK modem for professional and hobby communications.

- Completely compatible with your IMSAI, ALTAIR* SOL** or other S-100 microcomputers.
  Trademarks of *MITS, **Processor Technology
- Designed for use on the dial telephone or TWX networks, or 2-wire dedicated lines, meets all FCC regulations when used with a CBT coupler.
- All digital modulation and demodulation with on board cyrstal clock and precision filter mean that NO ADJUSTMENTS ARE REQUIRED
  - Bell 103 standard frequencies
  - Automated dial (pulsed) and answer
  - Originate and answer mode
  - 110 or 300 BPS speed select
  - Complete self test capability
  - Character length, stop bit, and parity
  - 90 day warranty and full documentation

PRICES:

BARE BOARD and Manual	$49.95
Assembled (48 hr. burn in)	$279.95
JG–DCA KIT	$159.95

NUMBER CRUNCHER

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NEW CATALOG NOW AVAILABLE

IAPS: International ASCII Publication Standard

How To Make Your Own Tapes On An 8080

By Alan R. Miller

Last month, the Floppy ROM was recorded at 300 baud. This created some problems in the amount of information that could be contained on the actual record. Therefore, only the five programs listed at the start of the IAPS* article were physically on the record, even though the article suggested that all 15 program segments existed on the ROM.*

Side two does contain the index to INTERFACE AGE database. We had originally planned to discuss, in depth, the use and structure of the database in this issue. However, due to deadline pressures, and other exhaustive work on IAPS, this will not be done until the July issue.

During the next several months IAPS will be expanded upon and further defined. It is our goal to make IAPS a useful tool for formating information on magnetic media.

Your comments regarding IAPS are very important to us. We are particularly interested in how well it worked, and if any reader has created code to read the IAPS formatted ROM into other machines than the 6800 and 8080.

Please address your comments to: IAPS, INTERFACE AGE Magazine, P.O. Box 1234, Cerritos, CA 90701. We will answer all letters and publish as many as possible.

ABSTRACT
A further discussion of the IAPS format and an 8080 program for making, loading, and verifying IAPS files.

INTRODUCTION
There are several problems associated with information exchange between computers. All programs ultimately have to be converted into machine language that each computer can understand. Assemblers produce low-level programs that generate a single set of machine instructions for each line of code. Each type of computer has a different architecture, with different types of instructions. Therefore, assembly language programs (and of course the resulting machine code) will operate only in the type of computer for which it was written. For example, the 8080 microprocessor has only one accumulator for doing general operations such as ADD, while the 6800 microprocessor has two. The 6800 instruction to load accumulator B cannot be directly implemented on the 8080. On the other hand, the 6800 performs input and output as though it were doing a memory operation, whereas the 8080 can send a byte directly from its one accumulator to a peripheral. Word sizes are different from machine to machine. Microcomputers use 8-bit words, whereas larger computers use word sizes of 16 bits, 32 bits, 36 bits, or 60 bits.

High-level languages such as BASIC, FORTRAN, and APL were invented to get around this incompatibility problem. Of course the processor ix>K (interpreter or compiler) that converts the user's program must be written for the particular machine it is to be used on. A BASIC interpreter written for an 8080 won't run on a 6800, but the user's source program that the interpreter processes is likely to run on either machine with only slight modifications, (if any). The user's program might be a linear curve fitter, an accounting package, or the game of LIFE written in BASIC.

David Ahl's book "101 BASIC Games" is an interesting collection of BASIC programs. Most of them will run on any computer. But this brings up another problem. Typing programs into your computer is not a very efficient way to transfer software. It is time consuming and also is likely to introduce mistakes that are hard to find. On the other hand, machine-readable programs on media such as paper tape, magnetic tape or disk are often machine specific. A North Star diskette can only be read with a North Star disk and an 8080 or Z80 microprocessor; BASIC on a MITS magnetic tape can only be read with a MITS cassette interface board and an 8080.

A SOLUTION
Last year INTERFACE AGE introduced the Floppy ROM, a plastic recording of computer programs that you can remove from the magazine, play on your phonograph and copy to your tape recorder. The resulting program on the magnetic tape can then be loaded into your computer. For such a development to be generally useful, the software must be in a high-level language such as BASIC or FORTRAN. Furthermore, the recording format must not be machine specific. Finally, certain control characters should not appear in the file since on some systems they sometimes turn things on or off.

In an effort to make the Floppy ROM more useful, INTERFACE AGE, in the May 1978 issue, introduced a new format called IAPS (International ASCII Publication Standard). This format has been carefully designed for the general interchange of information between computers, even though they may have very different architectures. The Floppy ROMs that appear in INTERFACE AGE will soon be in this IAPS format. It is also likely that INTERFACE AGE will require authors to submit computer programs associated with their articles in this IAPS format.

THE IAPS FORMAT
In case you just joined us, or can't find the May 1978 issue, let me summarize the format. The file is arranged into a series of blocks (records), partitioned into a header, the text, and the checksum. Each block corresponds to a single line of the original text, i.e., it contains the information between carriage returns. (If a binary file were encoded, each occurrance of a HEX 13, the ASCII carriage return, would start a new block.) The carriage returns themselves are left out. When the file is received and decoded back into the original text, the carriage returns are inserted into the proper place.

: SOH : Block # : STX : Text : ETX : Checksum :

*Floppy ROM and IAPS are trademarks of INTERFACE AGE Magazine, Cerritos, California

The Header

The start of each block is signaled by the ASCII SOH (start of header) byte (01 HEX). Then comes the block number, which is 1 for the first block, and increases sequentially for the rest of the blocks. Each digit of the block number is represented in ASCII decimal form without leading zeros. For example, the block number 128 would appear as an ASCII 1, an ASCII 2 and an ASCII 8. Since up to eight decimal digits are provided for, there can be lots of textural lines (or lots of 13 HEX bytes for binary text) transmitted in each file.

The Text

The beginning of the text section is indicated with the ASCII STX (start of text) byte (02 HEX). The text section might typically contain a single line of a BASIC source program. If any control characters appear in the original line (or the HEX bytes 00-1F in a binary file), they are converted to printing characters by performing a logical OR with 40 HEX. This turns on bit six and produces the characters @, the upper-case letters, backslash, square brackets, up arrow and back arrow. The ASCII DLE byte (HEX 10) precedes each converted control character so that it can be reconverted upon receipt of the file. The DLE character is the only control character in the text section. The ASCII ETX (end of text) byte (03 HEX) indicates the end of the text portion. It takes the place of the carriage return in the original text.

. . .this month's 8080 version has undergone a major revision in the handling of block numbers during a load operation.

The Checksum

The checksum appears last in the block. It is formed from the 16-bit sum without carry of all bytes after the SOH byte up to and including the ETX byte. The sum is converted to the two's complement, so that the receiving computer need only add it to the calculated sum and check for zero. (The sum of a number and its two's complement is zero.) But we're not done yet. The complemented checksum is then converted into four, printable, ASCII characters by ORing each half byte (four bits) with 40 HEX.

Each block begins after the checksum of the prior block. Its block number is one larger than the previous one. The end of the file is indicated with the ASCII EOT (end of transmission) byte (04 HEX) and follows the checksum of the last block.

TTHE REVISED 8080 PROGRAM

The May 1978 issue of INTERFACE AGE presented minimum programs for reading IAPS Files. The 8080 Assembly listing given this month is a major revision of the first version. It supports the following commands:

L	load IAPS file and decode
C	copy IAPS file directly to memory
D	dump file loaded with L or C (straight dump, no encoding)
M	make an IAPS file tape
V	verify an IAPS file tape against memory
CONTROL-C	correct keyboard error
CONTROL-X	return to monitor

Branch to the beginning of the program (START), and the prompt character > will appear at the address defined by CDATA in the assembly lising.

LOADING THE IAPS FILE TAPE

An IAPS source tape, such as you might get from Floppy ROMs in forthcoming issues of INTERFACE AGE, can be loaded into memory by typing an L, an address where program loading is to begin, and a carriage return. Spaces are ignored and so can be used freely. The file is read from the port defined by FSTAT/FDATA. If your only peripheral is a Teletype, you can load an IAPS paper tape by defining FSTAT/FDATA to be CSTAT/CDATA. Since the FSTAT routines don't echo the input, the Teletype won't print during a load operation, and so the computer won't fall behind.

During a load operation, the computer sums up the incoming data and compares it to the checksum at the end of each block. If they do not match, the corresponding block number is saved in a buffer. At the end of the load operation, the block numbers of incorrectly read blocks are printed on the console.

A STRAIGHT LOAD

The C command can be used to load a complete IAPS tape into memory so that it can be examined, or copied to a different type of medium. After typing a C, enter the start address as with the load command. While the tape is loading, the computer sums up the incoming bytes and compares them to the checksums, just as for the L command.

MAKING A TAPE

An IAPS source tape can be made from data in your memory. Type an M, the start address and stop address of the dump (both in four-character HEX format), and a carriage return. A leader of 72 nulls (binary zeros) will precede the file and a trailer of another 72 nulls will appear at the end of the file. These leaders correspond to six inches of blanks on a paper tape. If you are recording on magnetic tape or disk, you might want to reduce the number of nulls, which is set in subroutine LEADR with a MVI B,72 instruction.

VERIFY YOUR TAPE

After you have produced an IAPS file tape, you can verify that it is correct. Type a V, the start address and a carriage return. The verify command uses the same routines as the load command, only the move to memory instruction is skipped. The incorrect block numbers will be printed out at the end as for the load operation.

ERROR CORRECTION AND GETTING OUT

If you make a keyboard error, type a Control-C. This program will then restart giving the prompt >. When you are finished, type a Control-X to return to your monitor; the address defined by MONIT in the assembly language program (currently F800H). I have a 1K byte memory board addressed to F000 to F3FF HEX which is used for my stack and scratch pad memory. You may want to redefine the stack to somewhere beyond the end of this program.

THE FUTURE

In the coming months, INTERFACE AGE will present additional programs for use with IAPS files. While it is not apparent to the user, this month's 8080 version has undergone a major revision in the handling of block numbers during a load operation. Block numbers are now converted to BCD. This will make it easier to add error recovery. Future versions will have provisions for rereading missing blocks and those with checksum errors. Also, we plan to add a file-header block (numbered zero) and an end-of-file block. This will also aid in error recovery.

PROGRAM LISTING

```
                        ; PRØGRAM TØ LØAD, CREATE, VERIFY  AND DUMP
                        ; FILES IN THE INTERFACE AGE PUBLICATIØN FØRMAT
                        ; 8080 MICRØPRØCESSØR VERSIØN
                        ;
                        ; MARCH 22, 1978
                        ;
                        ; WRITTEN BY ALAN R. MILLER
                        ; NEW MEXICØ TECH, SØCØRRØ, NM  87801
                        ; 505-835-5619
                        ;
                        ;
        8000            .PHASE  $8000
                        ;
                        .EQUIV  .BYTE   DB      ;SET UP FØR
                        .EQUIV  .BLKB   DS      ; 8080 DIRECTIVES
                        .EQUIV  .ADDR   DW
                        ;
        F3A0            STACK   ==      $F3A0
        F800            MØNIT   ==      $F800   ;MØNIR ØN CØNTRØL-X
        0012            FSTAT   ==      $12     ;FILE SØURCE STATUS
        0013            FDATA   ==      $13     ;FILE SØURCE DATA
        0001            FIMSK   ==      1       ;INPUT MASK
        0002            FØMSK   ==      2       ;ØUTPUT MASK
        0012            TSTAT   ==      $12     ;TAPE STATUS
        0013            TDATA   ==      $13     ;TAPE DATA
        0002            TØMSK   ==      2       ;TAPE-ØUTPUT MASK
        0010            CSTAT   ==      $10     ;CØNSØLE STATUS
        0011            CDATA   ==      $11     ;CØNSØLE DATA
        0001            CIMSK   ==      1       ;CØNSØLE INPUT MASK
        0002            CØMSK   ==      2       ;CØNSØLE ØUTPUT MASK
        0001            SØH     ==      1       ;START ØF BLØCK
        0002            STX     ==      2       ;START ØF TEXT
        0003            ETX     ==      3       ;END ØF TEXT
        0004            EØT     ==      4       ;END ØF FILE
        0010            DLE     ==      16      ;CØNTRØL CHAR FØLLØWS
        000D            CR      ==      13      ;CARRIAGE RETURN
        000A            LF      ==      10      ;LINE FEED
8000    31 A0F3         START:  LXI     SP,STACK
8003    AF                      XRA     A       ;GET A ZERØ
8004    32 2F83                 STA     LFLAG   ;RESET LØAD FLAG
8007    32 2E83                 STA     EFLAG   ;ZERØ ERRØR CØUNT
800A    CD 2F82                 CALL    CRLF
800D    3E 3E                   MVI     A,">"
800F    CD B681                 CALL    ØUTT    ;PRINT A PRØMPT
8012    CD A181                 CALL    READ    ;GET TASK FRØM CØNSØLE
8015    FE 44                   CPI     "D"     ;DUMP FILE TØ TAPE
8017    CA 6E81                 JZ      DUMP
801A    FE 56                   CPI     "V"     ;VERIFY
801C    CA 3380                 JZ      LØAD
801F    FE 4D                   CPI     "M"     ;MAKE TAPE
8021    CA 4D82                 JZ      MAKE
8024    FE 4C                   CPI     "L"     ;LØAD TØ MEMØRY
8026    CA 3380                 JZ      LØAD
8029    FE 43                   CPI     "C"     ;CØPY ALL TØ MEMØRY
802B    C2 F581                 JNZ     ERRØR
802E    3E 01                   MVI     A,1
8030    32 2F83                 STA     LFLAG   ;SET LØAD FLAG
                        ;
                        ; INPUT FILE FRØM TERMINAL AND LØAD INTØ MEMØRY
                        ; (H,L) IS MEMØRY PØINTER, (B,C) IS DATA SUM
                        ;
8033    32 2D83         LØAD:   STA     TASK    ;SAVE THE TASK
8036    CD C281                 CALL    READHL  ;INPUT START ADDRESS
8039    CD 2782                 CALL    GØ      ;WAIT FØR CARR RET
803C    EB                      XCHG
803D    21 4E83                 LXI     H,CSUMT ;START CHECKSUM TABLE
8040    22 3B83                 SHLD    CPNTR   ;RESET PØINTER TØ START
8043    EB                      XCHG
8044    CD 2281         LØADN:  CALL    PUTIN   ;GET A BYTE
8047    FE 04                   CPI     EØT     ;END ØF FILE?
8049    CA 3F81                 JZ      DØNE    ;YES
804C    FE 01                   CPI     SØH     ;START ØF BLØCK?
804E    C2 4480                 JNZ     LØADN   ;LØØP UNTIL START
8051    AF                      XRA     A       ;GET A ZERØ
8052    47                      MØV     B,A     ;ZERØ THE DATA SUM
8053    4F                      MØV     C,A
8054    22 3983                 SHLD    MPNTR.  ;SAVE PØINTER
8057    21 3083                 LXI     H,BLØCK ;BLØCK-NUMBER BUFFER
805A    16 FF                   MVI     D,255   ;SET THE DIGIT CØUNT
                        ;
                        ; INPUT THE BLØCK NUMBER
                        ;
805C    E5              BLØCKN: PUSH    H       ;SAVE BUFFER PØINTER
805D    2A 3983                 LHLD    MPNTR   ;GET MEMØRY PØINTER
8060    CD 2281                 CALL    PUTIN   ;GET A BYTE
8063    22 3983                 SHLD    MPNTR   ;SAVE MEMØRY PØINTER
8066    E1                      PØP     H       ;GET BUFFER PØINTER
8067    77                      MØV     M,A     ;PUT IN BUFFER
8068    23                      INX     H       ;INCR BUFFER PØINTER
8069    14                      INR     D       ;INCREMENT THE CØUNT
806A    FE 02                   CPI     STX     ;END ØF NUMBER?
806C    C2 5C80                 JNZ     BLØCKN  ;LØØP UNTIL END
                        ;
                        ; CØNVERT THE DECIMAL DIGITS TØ TWØ BCD
                        ; DIGITS PER WØRD
                        ;
806F    21 3083                 LXI     H,BLØCK ;DIGIT BUFFER
8072    C5                      PUSH    B       ;GET SØME WØRK SPACE
8073    42                      MØV     B,D     ;DIGIT CØUNT TØ B
8074    11 3083                 LXI     D,BLØCK ;USE SAME BUFFER
8077    78                      MØV     A,B
8078    0E 00                   MVI     C,0
807A    E6 01                   ANI     1       ;SEE IF EVEN ØR ØDD
807C    C2 8980                 JNZ     PACK2   ;ØDD
807F    7E              PACK3:  MØV     A,M     ;GET DIGIT
8080    D6 30                   SUI     "0"     ;REMØVE ASCII BIAS
8082    07                      RLC
8083    07                      RLC             ;MØVE TØ UPPER HALF
8084    07                      RLC
8085    07                      RLC
8086    4F                      MØV     C,A     ;SAVE IN C
8087    05                      DCR     B       ;DECREMENT CØUNT
8088    23                      INX     H       ;MØVE ØLD PØINTER
8089    7E              PACK2:  MØV     A,M     ;NEXT DIGIT
808A    D6 30                   SUI     "0"
808C    B1                      ØRA     C       ;CØMBINE  UPPER HALF
808D    12                      STAX    D       ;PACKED WØRD IN BUFFER
808E    23                      INX     H       ;INCR BØTH PØINTERS
808F    13                      INX     D
8090    05                      DCR     B       ;DECREMENT DIGIT CØUNT
8091    C2 7F80                 JNZ     PACK3   ;GET SØME MØRE
8094    C1                      PØP     B       ;RESTØRE CHECKSUM
8095    2A 3983                 LHLD    MPNTR   ;RESTØRE DATA PØINTER
                        ;
                        ; INPUT THE TEXT
                        ;
8098    CD 1881         TEXT:   CALL    INBYTE  ;GET A BYTE
809B    FE 03                   CPI     ETX     ;END ØF BLØCK?
809D    CA C080                 JZ      DEND    ;YES, PRØCESS CHECKSUM
80A0    FE 10                   CPI     DLE     ;CØNTRØL CHARACTER?
80A2    C2 AD80                 JNZ     MØVE    ;NØ, PUT BYTE IN MEMØRY
80A5    CD 1881                 CALL    INBYTE  ;GET CØNTRØL CHARACTER
80A8    CD 2C81                 CALL    PUT3    ;PUT IN MEMØRY
80AB    E6 1F                   ANI     $1F     ;CØNVERT CØNTR CHAR
80AD    5F              MØVE:   MØV     E,A
80AE    3A 2D83                 LDA     TASK    ;CHECK THE TASK
80B1    FE 56                   CPI     "V"     ;VERIFYING?
80B3    CA B780                 JZ      SKIPL   ;YES
80B6    73                      MØV     M,E     ;PUT BYTE IN MEMØRY
80B7    7B              SKIPL:  MØV     A,E
80B8    BE                      CMP     M       ;IS IT THERE?
80B9    C2 FD81                 JNZ     MERR    ;NØ, QUIT
80BC    23                      INX     H       ;INCR MEMØRY PØINTER
80BD    C3 9880                 JMP     TEXT    ;NEXT BYTE
                        ;
                        ; END ØF BLØCK.  GET CHECKSUM AND CØMPARE TØ
                        ; CALCULATED SUM.
                        ;
80C0    3A 2F83         DEND:   LDA     LFLAG   ;CHECK LØAD FLAG
80C3    B7                      ØRA     A       ;SEE IF ZERØ
80C4    C2 CC80                 JNZ     DEN2    ;SKIP CR IF FULL LØAD
80C7    36 0D                   MVI     M,CR    ;CARR RET INTØ MEMØRY
80C9    C3 CE80                 JMP     DEN3
80CC    36 03           DEN2:   MVI     M,ETX
80CE    23              DEN3:   INX     H       ;INCREMENT PØINTER
80CF    C5                      PUSH    B       ;SAVE SUM
80D0    CD 0281                 CALL    FIXSM   ;FIRST TWØ CHARACTERS
80D3    57                      MØV     D,A     ;PUT IN H
80D4    CD 0281                 CALL    FIXSM   ;SECØND TWØ CHAR
80D7    5F                      MØV     E,A     ;PUT IN L
80D8    C1                      PØP     B       ;RETRIEVE SUM
80D9    EB                      XCHG            ;CHECKSUM TØ H,L
80DA    09                      DAD     B       ;ADD TØ CHECKSUM
80DB    7C                      MØV     A,H
80DC    B5                      ØRA     L       ; (H,L) ZERØ?
80DD    EB                      XCHG            ;PØINTER TØ H,L
80DE    CA 4480                 JZ      LØADN   ;ØK, START NEXT BLØCK
                        ;
                        ; CHECKSUM ERRØR.  SAVE BLØCK NUMBER IN
                        ; BUFFER FØR LATER LISTING.
                        ;  (THERE WØN'T BE TIME NØW).
                        ;
80E1    E5                      PUSH    H
80E2    11 3083                 LXI     D,BLØCK ;BLØCK NUMBER
80E5    2A 3B83                 LHLD    CPNTR   ;CHECKSUM TABLE PØINTR
80E8    1A              NCHAR:  LDAX    D       ;GET BLØCK CHARACTER
80E9    77                      MØV     M,A     ;PUT IN TABLE
80EA    13                      INX     D
80EB    23                      INX     H
80EC    22 3B83                 SHLD    CPNTR   ;SAVE PØINTER
80EF    FE 20                   CPI     " "
80F1    C2 E880                 JNZ     NCHAR   ;NEXT CHARACTER
80F4    36 01                   MVI     M,1     ;1 MARKS TABLE END
80F6    3A 2E83                 LDA     EFLAG   ;FTECH ERRØR CØUNT
80F9    3C                      INR     A       ;INCREMENT IT
80FA    27                      DAA             ;CØNVERT TØ DECIMAL
80FB    32 2E83                 STA     EFLAG   ;SAVE NEW VALUE
80FE    E1                      PØP     H       ;RESTØRE TEXT PØINTER
80FF    C3 4480                 JMP     LØADN
                        ;
                        ; INPUT TWØ BYTES FØR HALF ØF CHECKSUM.
                        ; CØNVERT TØ ØNE BINARY BYTE IN A
                        ;
8102    CD 0F81         FIXSM:  CALL    BYTE5   ;GET FIRST BYTE
8105    07                      RLC
8106    07                      RLC             ;RØTATE TØ UPPER HALF
8107    07                      RLC
8108    07                      RLC
8109    47                      MØV     B,A     ;SAVE IN L
810A    CD 0F81                 CALL    BYTE5   ;GET SECØND PART
810D    B0                      ØRA     B       ;CØMBINE BØTH PARTS
810E    C9                      RET
                        ;
                        ; GET A BYTE WITHØUT ALTERING CHECKSUM
                        ;
810F    CD 3381         BYTE5:  CALL    BYTE
8112    CD 2581                 CALL    PUT2    ;SEE IF CØPYING
8115    E6 0F                   ANI     $0F     ;KEEP LØWER THREE BITS
8117    C9                      RET
                        ;
                        ; INPUT A BYTE FRØM FILE, ADD TØ CHECKSUM.
                        ; CHECK FØR END ØF FILE.
                        ;
8118    CD 3381         INBYTE: CALL    BYTE    ;GET THE BYTE
811B    5F              INAY2:  MØV     E,A     ;SAVE BYTE IN E
811C    81                      ADD     C       ;ADD TØ SUM
811D    4F                      MØV     C,A     ;PUT NEW SUM BACK TØ C
811E    7B                      MØV     A,E     ;RESTØRE BYTE
811F    D0                      RNC             ;DØNE IF NØ CARRY
8120    04                      INR     B       ;ADD CARRY TØ B
8121    C9                      RET
                        ;
                        ; CHECK IF CØPYING ENTIRE TAPE INTØ MEMØRY
                        ;
8122    CD 1881         PUTIN:  CALL    INBYTE
```

```
8125  5F        PUT2:  MØV    E,A
8126  3A 2F83          LDA    LFLAG    ;CØPY CØMMAND?
8129  B7               ØRA    A
812A  7B               MØV    A,E
812B  C8               RZ              ;NØT CØPYING
812C  77        PUT3:  MØV    M,A
812D  BE               CMP    M
812E  23               INX    H        ;INCREMENT PØINTER
812F  C2 F581          JNZ    ERRØR
8132  C9               RET
                ;
                ; INPUT A BYTE FRØM FILE TERMINAL
                ;
8133  DB 12     BYTE:  IN     FSTAT    ;CHECK FILE STATUS
8135  E6 01            ANI    FIMSK    ;MASK FØR INPUT
8137  CA 3381          JZ     BYTE     ;LØØP UNTIL READY
813A  DB 13            IN     FDATA    ;GET BYTE
813C  E6 7F            ANI    127      ;STRIP PARITY
813E  C9               RET
                ;
                ; END ØF FILE.  PRINT PØINTER.
                ;
813F  CD 0882   DØNE:  CALL   ØUTHL
8142  36 05            MVI    M,5      ;BINARY 5 MARKS END
8144  3A 2E83          LDA    EFLAG    ;ANY CHECKSUM ERRØRS?
8147  B7               ØRA    A
8148  CA 0080          JZ     START    ;NØ, RESTART
814B  47               MØV    B,A      ;SAVE ERRØR CØUNT
814C  CD 2F82          CALL   CRLF
814F  78               MØV    A,B
8150  CD 0D82          CALL   ØUTHX    ;PRINT NUMBER ØF ERRØRS
8153  21 3D83          LXI    H,EMESG  ;PØINT TØ ERRØR MESSAGE
8156  CD 4382          CALL   SENDM    ;PRINT IT
                ;
                ; PRINT BLØCK NUMBERS WITH CHECKSUM ERRØRS
                ;
8159  CD 2F82   PLINES: CALL  CRLF
815C  7E        PLIN2: MØV    A,M      ;GET CHARACTER
815D  23               INX    H        ;INCREMENT PØINTER
815E  FE 01            CPI    1        ;1 MARKS TABLE END
8160  CA 0080          JZ     START    ;DØNE
8163  FE 20            CPI    " "      ;BLANK AT END
8165  CA 5981          JZ     PLINES   ;START ØN NEXT NUMBER
8168  CD B681          CALL   ØUTT     ;PRINT CHARACTER
816B  C3 5C81          JMP    PLIN2    ;NEXT CHARACTER
                ;
                ; RØUTINE TØ SEND TEXT IN MEMØRY TØ TAPE PØRT.
                ; ADD TIME DELAY AFTER CARRIAGE RETURN.
                ;
816E  CD C281   DUMP:  CALL   READHL   ;GET STARTING ADDRESS
8171  CD 2782          CALL   GØ       ;WAIT FØR CARR RET
8174  CD FB82          CALL   LEADR    ;PUNCH LEADER
8177  7E        DMP2:  MØV    A,M      ;FETCH BYTE
8178  23               INX    H        ;INCREMENT PØINTER
8179  FE 05            CPI    5        ;5 MARKS BUFFER END
817B  CA E182          JZ     PTRAL    ;DØNE, PUNCH TRAILER
817E  CD 9581          CALL   TØUT     ;ØUTPUT BYTE
8181  FE 0D            CPI    CR       ;CARRIAGE RETURN?
8183  C2 7781          JNZ    DMP2     ;CØNTINUE IF NØT
8186  16 78            MVI    D,120    ;ØUTER TIMING LØØP
```

```
8188  1E C8    DMP3:  MVI   E,200    ;INNER TIMING LØØP
818A  1D       DMP4:  DCR   E
818B  C2 8A81         JNZ   DMP4     ;LØØP ØN E
818E  15              DCR   D
818F  C2 8881         JNZ   DMP3     ;LØØP ØF D
8192  C3 7781         JMP   DMP2     ;DELAY DØNE
                ;
                ; RØUTINE TØ ØUTPUT A BYTE TØ TAPE
                ;
8195  F5       TØUT:  PUSH  PSW
8196  DB 12    TØUTW: IN    TSTAT    ;CHECK STATUS
8198  E6 02           ANI   TØMSK    ;MASK UNWANTED BITS
819A  CA 9681         JZ    TØUTW    ;LØØP UNTIL READY
819D  F1              PØP   PSW      ;GET BYTE
819E  D3 13           ØUT   TDATA
81A0  C9              RET
                ;
                ; CØNSØLE-INPUT RØUTINE
                ;
81A1  DB 10    READ:  IN    CSTAT    ;CHECK STATUS
81A3  E6 01           ANI   CIMSK    ;MASK FØR INPUT
81A5  CA A181         JZ    READ     ;LØØP UNTIL READY
81A8  DB 11           IN    CDATA    ;GET DATA
81AA  E6 7F           ANI   127      ;STRIP PARITY
81AC  FE 03           CPI   3        ;CØNTRØL-C
81AE  CA 0080         JZ    START    ;RESTART
81B1  FE 18           CPI   24       ;CØNTRØL-X
81B3  CA 00F8         JZ    MØNIT    ;RETURN TØ MØNITØR
                ;
                ; CØNSØLE ØUTPUT RØUTINE
                ;
81B6  F5       ØUTT:  PUSH  PSW
81B7  DB 10    ØUTW:  IN    CSTAT    ;CHECK STATUS
81B9  E6 02           ANI   CØMSK    ;MASK FØR ØUTPUT
81BB  CA B781         JZ    ØUTW     ;LØØP UNTIL READY
81BE  F1              PØP   PSW
81BF  D3 11           ØUT   CDATA
81C1  C9              RET
                ;
                ; INPUT AN ADDRESS TØ H,L FRØM THE CØNSØLE
                ;
81C2  D5       READHL: PUSH D
81C3  CD CD81         CALL  RDHEX    ;INPUT HIGH HALF
81C6  67              MØV   H,A
81C7  CD CD81         CALL  RDHEX    ;INPUT LØW HALF
81CA  6F              MØV   L,A
81CB  D1              PØP   D
81CC  C9              RET
                ;
                ; INPUT TWØ HEX CHARACTERS AND CØNVERT TØ
                ; A BINARY BYTE IN E
                ;
81CD  CD DB81  RDHEX: CALL  HEX2     ;READ UPPER CHARACTER
81D0  07              RLC
81D1  17              RAL            ;RØTATE
81D2  17              RAL            ;TØ UPPER HALF
81D3  17              RAL
81D4  5F              MØV   E,A
81D5  CD DB81         CALL  HEX2     ;READ LØWER HALF
81D8  83              ADD   E        ;CØMBINE BØTH
81D9  5F              MØV   E,A      ;SAVE IN E
81DA  C9              RET
                ;
                ; INPUT A HEX CHARACTER TØ A
                ;
81DB  CD A181  HEX2:  CALL  READ     ;CØNSØLE INPUT
81DE  FE 20           CPI   " "
81E0  CA DB81         JZ    HEX2     ;IGNØRE BLANKS
81E3  D6 30           SUI   "0"      ;REMØVE ASCII BIAS
81E5  DA F581         JC    ERRØR    ;ERRØR, LESS THAN "0"
81E8  FE 17           CPI   23
81EA  D2 F581         JNC   ERRØR    ;ERRØR, > "F"
81ED  FE 0A           CPI   10
81EF  D8              RC             ;A NUMBER 0-9
81F0  D6 07           SUI   7
81F2  FE 0A           CPI   10
81F4  D0              RNC            ;A LETTER A-F
81F5  3E 3F    ERRØR: MVI   A,"?"
81F7  CD B681         CALL  ØUTT     ;PRINT ? FØR ERRØR
81FA  C3 0080         JMP   START
                ;
                ; MEMØRY ERRØR
                ;
81FD  3E 4D    MERR:  MVI   A,"M"
81FF  CD B681         CALL  ØUTT     ;PRINT AN M
8202  CD 0882         CALL  ØUTHL    ;PRINT THE PØINTER
8205  C3 0080         JMP   START    ;TRY AGAIN
                ;
                ; ØUTPUT A DØUBLE BYTE IN HEX
                ;
8208  7C       ØUTHL: MØV   A,H      ;GET H
8209  CD 0D82         CALL  ØUTHX    ;PRINT IT
820C  7D              MØV   A,L      ;GET L
                ;
                ; CØNVERT A BINARY BYTE TØ TWØ HEX CHARACTERS
                ; AND PRINT THEM
                ;
820D  F5       ØUTHX: PUSH  PSW
820E  F5              PUSH  PSW
820F  1F              RAR
8210  1F              RAR            ;RØTATE UPPER
8211  1F              RAR            ;CHARACTER TØ
8212  1F              RAR            ;LØWER
8213  CD 1C82         CALL  HEX1     ;UPPER CHARACTER
8216  F1              PØP   PSW      ;LØWER CHARACTER
8217  CD 1C82         CALL  HEX1
821A  F1              PØP   PSW
821B  C9              RET
                ;
                ; ØUTPUT A HEX CHARACTER FRØM
                ; LØWER FØUR BITS
                ;
821C  E6 0F    HEX1:  ANI   $0F      ;MASK UPPER FØUR BITS
821E  C6 90           ADI   $90
```

```
8220  27              DAA            ;INTEL DAA TRICK
8221  CE 40           ACI   $40
8223  27              DAA
8224  C3 B681         JMP   ØUTT
                ;
                ; LØØK FØR A CARRIAGE RETURN AT END
                ; ØF CØNSØLE INPUT LINE
                ;
8227  CD A181  GØ:    CALL  READ
822A  FE 0D           CPI   CR
822C  C2 F581         JNZ   ERRØR
                ;
                ; CARRIAGE RETURN, LINE FEED AND NULLS
                ;
822F  3E 0D    CRLF:  MVI   A,CR
8231  CD B681         CALL  ØUTT
8234  3E 0A           MVI   A,LF
8236  CD B681         CALL  ØUTT
8239  AF              XRA   A        ;GET A NULL
823A  CD B681         CALL  ØUTT
823D  CD B681         CALL  ØUTT
8240  C3 B681         JMP   ØUTT
                ;
                ; SEND AN ASCII MESSAGE TØ CØNSØLE UNTIL
                ; UNTIL A BINARY ØNE IS FØUND.
                ;  (H,L) IS MEMØRY PØINTER.
                ;
8243  7E       SENDM: MØV   A,M      ;FETCH BYTE
8244  CD B681         CALL  ØUTT     ;PRINT IT
8247  23              INX   H        ;INCREMENT PØINTER
8248  B7              ØRA   A        ;ZERØ AT END
8249  C2 4382         JNZ   SENDM    ;KEEP GØING
824C  C9              RET
                ;
                ; MAKE AN IAPS TAPE
                ;
824D  21 0000  MAKE:  LXI   H,0
                ;     LXI   H,8888H
8250  22 3083         SHLD  BLØCK    ;ZERØ BLØCK NUMBER
8253  22 3283         SHLD  BLK2
8256  CD C281         CALL  READHL   ;START ADDRESS
8259  EB              XCHG
825A  CD C281         CALL  READHL   ;STØP ADDRESS
825D  EB              XCHG
825E  CD 2782         CALL  GØ       ;CARRIAGE RETURN?
8261  CD FB82         CALL  LEADR    ;PUNCH LEADER
8264  7B       NEWBL: MØV   A,E      ;NEW BLØCK
8265  95              SUB   L        ;HØW FAR TØ END?
8266  7A              MØV   A,D
8267  9C              SBB   H
8268  DA DC82         JC    LBLK     ;DØNE
826B  3E 01           MVI   A,SØH
826D  CD 1783         CALL  PBYTE    ;PUNCH SØH
8270  AF              XRA   A        ;GET A ZERØ
8271  32 3883         STA   BLKL     ;ZERØ BLØCK LENGTH
8274  47              MØV   B,A      ;ZERØ THE
8275  4F              MØV   C,A      ; CHECKSUM
8276  E5              PUSH  H
8277  D5              PUSH  D
8278  21 3083         LXI   H,BLØCK  ;BLØCK NUMBER
827B  7E       NEW2:  MØV   A,M      ;GET BLØCK NUMBER
827C  3C              INR   A        ;INCREMENT IT
827D  27              DAA            ;CØNVERT TØ DECIMAL
827E  77              MØV   M,A      ;PUT IT BACK
827F  DA 7B82         JC    NEW2     ;CØNTINUE IF CARRY
8282  21 3383         LXI   H,BLK4   ;HIGH END ØF BLØCK #
8285  16 04           MVI   D,4      ;4 BYTES
8287  7E       NEW3:  MØV   A,M
8288  B7              ØRA   A
8289  CA 9A82         JZ    NEW4     ;SKIP LEADING ZERØS
828C  FE 0F           CPI   15
828E  DA 9782         JC    NEW5     ;LEFT HALF IS ZERØ
8291  CD 0683         CALL  PUN2     ;PUNCH BLØCK NUMBER
8294  C3 9A82         JMP   NEW4
8297  CD 0F83  NEW5:  CALL  PNHEX1
829A  2B       NEW4:  DCX   H
829B  15              DCR   D        ;DECREMENT CØUNT
829C  C2 8782         JNZ   NEW3
829F  D1              PØP   D
82A0  E1              PØP   H
82A1  3E 02           MVI   A,STX
82A3  CD 1783         CALL  PBYTE    ;PUNCH STX
82A6  7E       NEXTD: MØV   A,M      ;GET DATA BYTE
82A7  23              INX   H        ;INCREMENT PØINTER
82A8  FE 0D           CPI   CR
82AA  CA C982         JZ    ENDBL    ;CARR RET ENDS BLØCK
82AD  FE 20           CPI   " "
82AF  D2 BB82         JNC   PDATA    ;NØT CØNTRØL CHAR
82B2  F5              PUSH  PSW
82B3  3E 10           MVI   A,DLE    ;INDICATE CØNTRØL CHAR
82B5  CD 1783         CALL  PBYTE
82B8  F1              PØP   PSW
82B9  F6 40           ØRI   $40      ;CØNVERT CØNTRØL CHAR
82BB  CD 1783  PDATA: CALL  PBYTE    ;PUNCH DATA
82BE  3A 3883         LDA   BLKL
82C1  3C              INR   A        ;INCREMENT BLØCK CØUNT
82C2  27              DAA            ;CØNVERT TØ DECIMAL
82C3  32 3883         STA   BLKL     ;SAVE NEW BLØCK CØUNT
82C6  C3 A682         JMP   NEXTD    ;NEXT BLØCK
                ;
                ; END ØF BLØCK
                ;
82C9  3E 03    ENDBL: MVI   A,ETX
82CB  CD 1783         CALL  PBYTE    ;PUNCH ETX
82CE  78              MØV   A,B      ;CHECKSUM (HIG HALF)
82CF  2F              CMA            ;CØMPLEMENT IT
82D0  CD E782         CALL  PSUM     ;PUNCH 2 HIGH CHAR
82D3  79              MØV   A,C      ;CHECKSUM (LØW HALF)
82D4  2F              CMA            ;CØMPLEMENT IT
82D5  3C              INR   A        ;FØRM TWØS CØMPLELENT
82D6  CD E782         CALL  PSUM     ;PUNCH 2 LØW CHAR
82D9  C3 6482         JMP   NEWBL    ;START NEXT BLØCK
                ;
                ; END ØF FILE, PUNCH EØT
                ;
```

```
82DC   3E 04    LBLK:   MVI     A,EØT
82DE   CD 2183          CALL    PØUT
82E1   CD FB82  PTRAL:  CALL    LEADR    ;PUNCH TRAILER
82E4   C3 0080          JMP     START
                ;
                ; PUNCH CHECKSUM
                ;
82E7   F5       PSUM:   PUSH    PSW
82E8   1F               RAR
82E9   1F               RAR
82EA   1F               RAR
82EB   1F               RAR
82EC   E6 0F            ANI     $0F      ;STRIP UPPER 4 BITS
82EE   F6 40            ØRI     $40      ;CØNVERT TØ A LETTR
82F0   CD 2183          CALL    PØUT     ;PUNCH UPPER HALF
82F3   F1               PØP     PSW
82F4   E6 0F            ANI     $0F      ;STRIP UPPER BITS
82F6   F6 40            ØRI     $40      ;CØNVERT
82F8   C3 2183          JMP     PØUT
                ;
                ; PUNCH A LEADER
                ;
82FB   AF       LEADR:  XRA     A        ;GET A NULL
82FC   06 48            MVI     B,72     ;NUMBER ØF NULLS
82FE   CD 2183  NLDR:   CALL    PØUT
8301   05               DCR     B
8302   C2 FE82          JNZ     NLDR
8305   C9               RET
                ;
                ; PUNCH TWØ HEX CHARACTERS FRØM A BINARY BYTE
                ;
8306   F5       PUN2:   PUSH    PSW
8307   1F               RAR
8308   1F               RAR
8309   1F               RAR
830A   1F               RAR
830B   CD 0F83          CALL    PNHEX1   ;PUNCH UPPER HALF
830E   F1               PØP     PSW
                ;
                ; PUNCH A HEX CHARACTER FRØM LØWER FØUR BITS
                ;
830F   E6 0F    PNHEX1: ANI     $0F      ;MASK UPPER FØUR BITS
8311   C6 90            ADI     $90
8313   27               DAA
8314   CE 40            ACI     $40
8316   27               DAA
                ;
                ; PUNCH A BYTE AND ADD TØ CHECKSUM
                ;
8317   F5       PBYTE:  PUSH    PSW
8318   81               ADD     C        ;ADD TØ CHECKSUM
8319   4F               MØV     C,A
831A   78               MØV     A,B
831B   CE 00            ACI     0        ;ADD CARRY TØ HIGH HALF
831D   47               MØV     B,A
831E   C3 2283          JMP     PØUTW
                ;
                ; PUNCH A BYTE
                ;
8321   F5       PØUT:   PUSH    PSW
8322   DB 12    PØUTW:  IN      TSTAT
8324   E6 02            ANI     TØMSK
8326   CA 2283          JZ      PØUTW
8329   F1               PØP     PSW
832A   D3 13            ØUT     TDATA
832C   C9               RET
                ;
832D 0001       TASK:   DS      1        ;SAVE THE TASK
832E   00       EFLAG:  DB      0        ;CHECKSUM ERRØR CØUNT
832F   00       LFLAG:  DB      0        ;LØAD FLAG
8330   00 00    BLØCK:  DB      0,0      ;SAVE BLØCK NUMBER
8332   00       BLK2:   DB      0
8333   00       BLK4:   DB      0
8334 0004               DS      4
8338   00       BLKL:   DB      0        ;BLØCK LENGTH
8339   00 00    MPNTR:  DW      0        ;MEMØRY PØINTER
833B   4E 83    CPNTR:  DW      CSUMT    ;CHECKSUM TABLE PØINTR
833D   20 43 48 EMESG:  .ASCIZ  " CHECKSUM ERRØRS";,0
       45 43 4B
       53 55 4D
       20 45 52
       52 4F 52
       53 00
834E 0028       CSUMT:  DS      40       ;TABLE ØF CHECKSUMMED
                                         ;RECØRDS
                        .END
```

SYMBOL TABLE

```
A      =%0007     B      =%0000     BLKL      8338     BLK2      8332
BLK4     8333     BLØCK    8330     BLØCKN    805C     BYTE      8133
BYTE5    810F     C      =%0001     CDATA =  0011   G CIMSK =  0001   G
CØMSK =  0002   G CPNTR    833B     CR    =  000D   G CRLF      822F
CSTAT =  0010   G CSUMT    834E     D      =%0002     DEND      80C0
DEN2     80CC     DEN3     80CE     DLE   =  0010   G DMP2      8177
DMP3     8188     DMP4     818A     DØNE      813F     DUMP      816E
E      =%0003     EFLAG    832E     EMESG     833D     ENDBL     82C9
EØT   =  0004   G ERRØR    81F5     ETX   =  0003   G FDATA =  0013   G
FIMSK =  0001   G FIXSM    8102     FØMSK =  0002   G FSTAT =  0012   G
GØ       8227     H      =%0004     HEX1      821C     HEX2      81DB
INAY2    811B     INBYTE   8118     L      =%0005     LBLK      82DC
LEADR    82FB     LF    =  000A   G LFLAG     832F     LØAD      8033
LØADN    8044     M      =%0006     MAKE      824D     MERR      81FD
MØNIT =  F800   G MØVE     80AD     MPNTR     8339     NCHAR     80E8
NEWBL    8264     NEW2     827B     NEW3      8287     NEW4      829A
NEW5     8297     NEXTD    82A6     NLDR      82FE     ØUTHL     8208
ØUTHX    820D     ØUTT     81B6     ØUTW      81B7     PACK2     8089
PACK3    807F     PBYTE    8317     PDATA     82BB     PLINES    8159
PLIN2    815C     PNHEX1   830F     PØUT      8321     PØUTW     8322
PSUM     82E7     PSW    =%0009     PTRAL     82E1     PUN2      8306
PUTIN    8122     PUT2     8125     PUT3      812C     RDHEX     81CD
READ     81A1     READHL   81C2     SENDM     8243     SKIPL     80B7
SØH   =  0001   G SP     =%0008     STACK =  F3A0   G START     8000
STX   =  0002   G TASK     832D     TDATA =  0013   G TEXT      8098
TØMSK =  0002   G TØUT     8195     TØUTW     8196     TSTAT =  0012   G
X      =%000A     Y      =%000B
```

The Westminster XEK Assembler for the North Star Disk

Reviewed by Alan R. Miller, Contributing Editor

The North Star minifloppy disk is perfect for those who want the increased speed of a disk over magnetic or paper tape for program storage, but don't need the 300K-byte storage capacity of a full-size floppy. The price is a lot more than what you will pay for a cassette tape system but considerably less than for a big floppy. At this time, the North Star system comes with a disk operating system (DOS) and an extended BASIC. If you need an assembler, you will have to look elsewhere.

I have integrated the MITS Software Package II assembler with my own system monitor and the North Star DOS so that I can load and save assembler source files on the diskettes. However, one of the biggest disadvantages of the MITS assembler is that it does not produce an assembly listing, a format that combines the original source listing and the resulting object code on the same line. I then assembled the Processor Technology Software Package 1 (SP 1) assembler with the MITS assembler. SP 1 produces an assembly listing, but has a lot of disadvantages. The values PSW and SP must be defined in each program, four-digit line numbers must be entered at the beginning of each line, and there is no text editor or tab counter.

The Byte Shop of Westminster, California offers an assembler/disassembler package for the North Star floppy that takes care of most of these problems. It produces an assembly listing, provides an autonumber feature and has a tab counter. Actually, two separate packages, an assembler and a disassembler, are combined on a single diskette for $48. The assembler software is integrated with the North Star DOS requiring 8K bytes. Additional space is needed for the symbol table, the source program and the assembled object code.

The XEK assembler uses the input-output routines in DOS that you have already written (one of the advantages of North Star compatible software). Some people do their output from the B or C register, others from the stack (POP PSW). Some terminal ports are addressed to 0/1 others to 10/11 HEX. Some status flags are bits 0,1, others are bits 6,7 and still others are 0 and 7 (I have samples of all of these). And further, some status registers indicate ready on a logic 1 and others on a logic 0. It's a pleasant change to put someone else's diskette into your drive and have his program work immediately on your machine! That was my experience with the XEK package.

There are two assembly language formats commonly used for the 8080 microprocessor. Intel's style is free-formatted and uses colons after labels and a semicolon before comments. A second style, apparently made popular by Processor Technology with their Software Package 1 assembler, does not require colons after labels and indicates comments with an asterisk. The SP 1 assembler, however, is not free-formatted, and so all fields must be accounted for. This means that a period or other free character must be placed in the operand field if a comment is needed for instructions that don't have operands (such as DAA and SMA). The XEK assembler is compatible with both the Intel and PTCo formats in that colons after labels are optional (although they sometimes don't print on the assembly listing), and either a semicolon or an asterisk can be used to indicate the start of a comment. The fixed format, though, means that the operand field must be indicated if a comment is needed.

Source programs are stored in the same format used by the SP 1 assembler: a byte giving the distance to the next line, a 4-digit ASCII line number, the text and a carriage return. Most other assemblers do not put into the buffer a byte indicating the distance to the next line. The MITS package stores only the text, tab characters and a carriage return (no line feed or line number). If you are now using the PTCo SP 1, you can give your existing source programs directly to XEK. If you have been using another assembler, you may have a problem getting your old source programs into the new assembler. I wrote a program to convert MITS source files in one part of memory to XEK format in another part of memory.

The XEK monitor/assembler package provides 30 commands, using the letters A-Z and the symbols : + ? and @. These allow the user to do such things as display memory locations in HEX, move a block of memory to another location, change memory locations, load and save programs on magnetic tapes and, of course, load and save named files on the North Star disk. The assembler commands are similar to those of the PTCo SP 1, except that the latter uses four-character commands. In fact, much of the XEK assembler code is identical to SP 1, except that the inefficient original code has been cleaned up. For example, there were a lot of places where a CALL was followed by a RET. These have been replaced by a JMP.

You can create an assembler source file by giving the F command, the file name and its starting address. Then, merely press the space bar at the beginning of each line and the next line number appears like magic. The autonumber increment can be changed with the S command. The label, if any, is typed and the space bar is pressed again. This time the cursor moves over to the next field (eight columns). The single space that was entered from the keyboard is actually placed into the source file. But when the file is listed with the P command, each space is interpreted as a tab character. The proper number of spaces is then output so that all the fields will line up. Of course, a space used as a literal, embedded in the quotes, will not be interpreted as a tab. There is also an L command to display the file as actually entered.

Two of the biggest problems with the PTCo SP 1 are also present in XEK assembler! No text editor, and the lack of an ASCII pseudo op. In the XEK assembler, the DB (define byte) and DW (define word) directives only allow a single argument. If you want to include a 20-character error message in your source program, you have to enter it as 20 DB statements or 10 DW statements (in the latter case, the characters are entered two to a line but in reverse order). Most assemblers have solved this problem either by having an ASCII directive or by allowing multiple arguments to the DB statement.

An even bigger problem is the lack of a full text editor. XEK does have a character-oriented editor as in BASIC.

If an error is noticed when it is typed, the back-arrow key can be pressed to delete it. But after a carriage return has been entered, the entire line must be typed over if it is incorrect. If another mistake is made, the line must be typed again, etc. Unless you are very good at typing, it may take a lot of effort to get all the errors out of your source program.

Fortunately, there is a solution to this problem. I have written a full text editor for the PTCo SP 1 which will appear soon in INTERFACE AGE. The article will give all the patch points needed for both assemblers. Since the code at all of the patch points in the SP 1 assembler is identical to that in the XEK assembler, my editor can be used with either. The only problem is that all of the letters A-Z have been used in the XEK program. But since there are two tape load commands and two tape save commands, I used one of these for the command to branch to my text editor. Since the source is available for the SP 1 assembler, I have incorporated both a tab counter and the text editor into my package. But since I don't have access to the XEK source, I couldn't incorporate it directly into the XEK package. In this case, the editor is assembled to run at a separate location, and so has to be separately loaded. I was surprised to find how relatively small a full text editor is (300 bytes in this case), and, therefore, am puzzled as to why more packages don't incorporate them.

If you haven't gotten around to writing your own system monitor, the combination of features between the North Star DOS and XEK packages gives you almost all the features you need to reassemble the programs appearing in INTERFACE AGE, or to write your own programs for submission to INTERFACE AGE.□

Insert To Stop TV Display

By John Musgrove

Many of the iterative computational programs that are available, including Loan Payment and Compound Interest, were written to output to a printer rather than to a monitor. For the user having only a monitor, the output moved off the monitor as fast as new lines were entered. The problem is one of more lines of output than are available on the monitor. While "CONTROL C" can interrupt the operation of the program, a method of programming the interruption into the printout would be preferable.

The following procedure describes how a program interrupt was inserted into several iterative programs purchased from Digital Group Software Systems. The same procedure can be used for other iterative printouts as well. Because the Digital Group monitor displays only sixteen lines, this procedure displays pages of twelve lines each. The number of lines in a page could be altered by the user to fit his own monitor.

Starting with the initial iteration:

```
100 FOR J = 1 TO M          M greater than 12
110 PRINT X(J)
120 NEXT J
```

one must establish the number of "pages" to be printed and therefore how many times to iterate the interrupt. The following eleven statements substitute for the above three and perform the desired function:

```
100 K = M/12
101 K = INT(K) + 1
102 FOR L = 1 TO K
103 K1 = (L-1)*(12) + 1
104 K2 = L*12
105 FOR J = K1 TO K2
110 PRINT X(J)
111 IF J = M THEN 121
112 NEXT J
113 INPUT"TO CONTINUE HIT THE RETURN
    KEY",B$
120 NEXT L
```

Where: K = The number of pages, whole or fractional
K1 = The lower limit of J for page L
K2 = The upper limit of J for page L
L = The page number being printed at any time
M ⁵ The total number of iterations desired
12 = The number of lines on a page

A description of the program steps is as follows:

100 and 101	Establish the number of pages
102	Open a loop for printing pages
103 and 104	Set the intermediate limits for J
105	Open a loop for printing J
110	Print the desired functions of J
111	Check for J = M to exit the loop
112	Close the loop for printing J
113	Interrupt the printout and give instructions for continuation
120	Close the loop for printing pages

The insertion of this procedure in iterative display programs will allow the user without hardcopy printout to see all the printout as it is displayed and not just the last few lines. Care should be taken to assure that none of the variables introduced in this procedure are already used in the host program. Redefinition of the variables can eliminate such a problem and not alter the effect of the procedure.

DEBBI — A User Report

By Dr. Jerald L. Ripley

DEBBI™ (Disk Extended BASIC By iCOM), is like the name implies — a disk oriented operating system, and 16K BASIC interpreter. DEBBI sells for approximately $125, and is available from most computer stores.

SOME FLAWS

After obtaining it, I found two major problems in DEBBI — the first of which, in my opinion, made it unfit for use. Consequently, I have altered DEBBI to eliminate this flaw, and would like to pass the modification along to fellow users.

DEBBI has the capability of saving and loading programs on floppy disk. To save a program, type in "DSAVE", the program will be placed in a disk file previously defined when the interpreter was initially loaded. To load a program, type in "DLOAD", and the program will be placed into memory from a file previously defined when the interpreter was loaded.

The major problem with DEBBI is the program will load only as fast as it can be printed on the console terminal. There is no way, in the original software, to prevent this printout. Thus, to load a large BASIC program, which should take five seconds, as long as 15 minutes can be spent for the load to take place.

CORRECTING THE PROBLEM

The procedure to correct this problem is shown in Program 1, using the edit command in FDOS-III. This correction will allow your program to load without the printout, and will ring the bell on the terminal when loading is completed. (The assumption is made that DEBBI exists on the System Disk on drive #0.) The procedure I use to illustrate this method is to give the computer printout of the actual computer transactions necessary to implement these changes. Output from the computer is underlined, and comments to the far right were printed by using the "local" button on the terminal. Note: Line 0020, the "D301" may need to be changed, depending on the I/O configuration.

The second major problem with DEBBI, which I would not attempt to correct without the source listing, is the problem of program segmentation. Segmenting is a procedure which is used when a program too large for the computer is being used. The program is broken into several smaller segments, and called when needed.

Segmenting makes it possible to load the first segment into the computer, and execute it. The program will run until it approaches the end. At the end point all pertinent variables are saved on disk, and the second segment of the program is called and executed. The second program segment begins by retrieving all variables from disk, then continuing on, (possibly calling a third segment), and so on. For example, the following BASIC program, written in BASIC ETC™:

```
10 Input X,Y
20 Let Z=Y*Y
30 Print X,Y,Z
40 End
```

could be segmented into two parts, as shown:

```
 5 Open FLO,out,0,100     open data file at sector 100
10 Input X,Y
20 Let Z=X*Y
30 Put FLO,X,Y,Z          Save values of X,Y,Z on disk
40 Close FLO
50 LOAD 0,500,R           load program segment at
                          sector 500 & run=R
```

Second segment stored at sector 500:

```
10 Open FLO,IN,0,100      open data file at sector 100
20 Get FLO,X,Y,Z          get data generated by
                          previous program segment
30 Print X,Y,Z
40 CLOSE FLO
50 End
```

DEBBI, however, does not have the capability of program segmentation. In order to run a program, it must fit completely into the available computer memory (DEBBI itself, takes 16K).

SOME OTHER PROBLEMS

There are a few minor problems which bear mentioning, and hopefully will be corrected in the next version of DEBBI. For example, if data is being written to a file on disk, DEBBI writes the information to the first file it finds in the directory which has the proper name. In FDOS-II, this would have been acceptable, since it was impossible to have two files with the same name. However, in FDOS-III, it is possible to delete files without packing the disk. This allows files to have the same name showing in the directory, with all but one having an attribute indicating they are deleted files. Therefore, data may be written to a deleted file, and unless this is realized, the data may be destroyed the next time the disk is packed (eliminate deleted files).

Another minor flaw is that DEBBI does not dynamically allocate disk space for data files. The user must guess at how large a file must be to hold the data. However, if the estimate is smaller than the size of the file, that is the file is too small to hold the data, then the program will blow.

SUMMARY

Aside from these flaws, which are expected from any new introduction of a BASIC interpreter, my opinion is that for the price, DEBBI is an excellent BASIC. I do not know for sure that the rumor concerning DEBBI being a Mits BASIC is true, but I can say that I have successfully implemented a randomly selected 7K basic program written in Mits 4.0 BASIC without any alteration, (no disk I/O was present in this program).□

ABOUT THE AUTHOR

Dr. Jerald L. Ripley received his Ph.D. in 1972 from the University of Oklahoma in Information and Computing Science. Since then he has been employed by Stephen F. Austin State University, in Nacogdoches, Texas, where he teaches courses in microprocessing and software development. He is also a consultant for a firm marketing small business systems and custom software.

PROGRAM LISTING

```
ICOM FDOS-III ALTAIR/IMSAI VER. 1.0

!EDIT,DEBBI,NEWDB                                    LOAD 200 LINES INTO EDITOR BUFFER

ICOM TEXT EDITOR VER 1.
@A$$
@A$$
@A$$                                                 HIT RETURN AFTER NEXT THREE LINES
@A$$
@I:10000000E5219C0F3600233600233600E1C39F2AEA
:10001000FE1BC22800F5E5219C0F36CD23364F2369
:1000200036093E07D301E1F1FE0FC0C39A0F00006D          SEARCH FOR LINE 092C
$$
@S:10092$$
@CC39FC1$C30060$$
@-1L$$
@1L$$                                                CORRECTED LINE #092C
@1T$$                                                GO TO LINE 093C
:10092C00F52FC3722FC38D2FC3712BC3442BC30060
@1L$$
@C3C002A$3C0000$$
@C2A0C$2A36$$
@-1L$$
@1L$$                                                CORRECTED LINE #093C
@1T$$                                                WRITE 200 LINES FROM BUFFER TO NEWDB
:10093C0000C38E2BC3772BC3652AC300C0C3D22A36
@200P$$
@A$$
@A$$
@A$$
@A$$
@200P$$
@A$$
@A$$
@A$$                                                 SEARCH FOR LINE 0F9F
@A$$
@S:100F9F$$
@CFE0FC0$C31000$$
@CCC3F$CC39$$
@-1L$$
@1L$$                                                CORRECTED LINE #0F9F
@1T$$
:100F9F00C1F1C9CD5209E67FC310003A6C05B7CC39
@E$$
```

TMS 9900 Interactive Monitor Part I

By Burt Johnson

INTRODUCTION

DDT99 V1.2 is an interactive assembly/disassembly and debugging tool created for the TMS9900 microprocessor. This monitor allows both interaction and tracing of programs in memory, and fully supports a host computer. It is intended in using this program, that the TMS9900 hardware will have the capability to stand alone, but will also have at least two RS232 ports — one to the user's terminal and one to the host computer. The host computer is used for mass storage of terminal conversation (see Command U), assembly and linking of large assembly or high-level language programs for subsequent 'downloading' into the micro (see Command <Control-T>), or as a computer in its own right (see Command K or /). The host computer that is supported by this version of DDT99 is a CDC6400 computer operating under the KRONOS timeshare monitor, specifically as implemented at the Scientific Computer Center at Tektronix. This system will operate fully without being hooked into such a host computer, except that certain commands that require host response may hang up — however, this will never occur if the host is not specifically called for in a command (K, /, or U). From here on in the article, reference to KRONOS is understood to mean 'the host computer.'

This monitor, as supplied, has the following:
- 4 commands to dump memory (Q,L,P, <Control-P>)
- 5 commands to set memory (',R,Z,<Control-P>, <Control-T>)
- 4 ways to execute a program under test (G,S,T,J)
- 2 types of breakpoints (N,I)
- 2 arithmetic and conversion commands (= ,$)
- 5 user program parameter modification commands (,,-,;,W,O)
- 2 hardware support commands (H,<Control-D>)
- 2 paper tape support commands (<Control-R>, <Control-P>)
- 4 'other' commands (X.U.V.M)
- 4 'KRONOS' mode commands (<Control-C>, <Control-U>,<Control-T>, <ALT MODE>)

Full mnemonic resident assembler/disassembler, and customizing capacity for expansion with user-defined commands.

REQUIRED HARDWARE

This software system has been developed prior to any standardized hardware system being developed. The hardware requirements for any system desiring to use DDT99 V1.2 is as follows:

2K words of PROM addressed at $F000 to $FFFF for standard commands

1K words of PROM with optional commands can be supported at $E800

256 words of RAM from address $E600 to $E7FF

Interrupt vectors must be in RAM in low memory address space or preloaded in ROM with correct addresses for current version

A 'LOAD' button to cause DDT99 V1.2 to vector through address $FFFC to Restart

Two UARTs — one talking to a terminal and one to KRONOS. Both must be Intel 8251 and on low byte of data bus
- KRONOS UART control word address $E11E
- KRONOS UART data word address $E01E
- KRONOS interrupts on Level 3
- Terminal UART control word address $E11C
- Terminal UART data word address $E01C
- Terminal interrupts on Level 2
- Paper tape is supported in parallel to the terminal

One addressable address breakpoint latch
- LOAD address $E01A
- Upon address match, interrupts on Level 1
- Reset address on CRU bus Address 1
- Reset via software clocking with SBO 1, SBZ 1

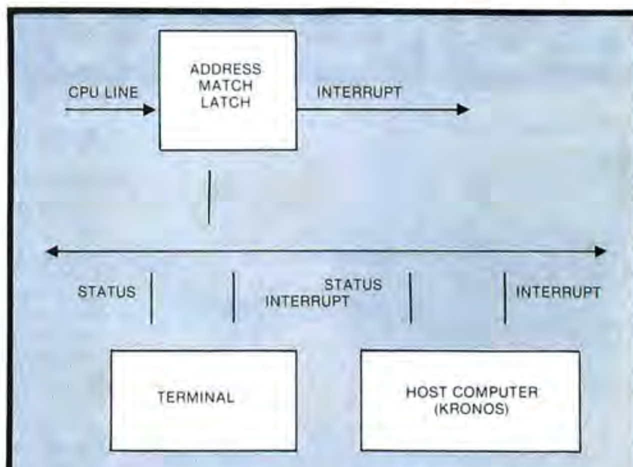

Figure 1. Hardware Block Diagram

HARDWARE CONFIGURATION

Memory Layout

The memory layout required to use the DDT99 V1.2 monitor is as follows:

$0000 to $003F	interrupt vectors required by processor
$0040 to $DFFF	reserved for user program
$E000 to $E5FF	reserved for hardware addresses
$E600 to $E7FF	reserved for DDT99 V1.2 scratchpad — do not use
$E800 to $EFFF	reserved for optional commands of each user
$F000 to $FFFF	reserved for DDT99 V1.2 PROMs with standard commands

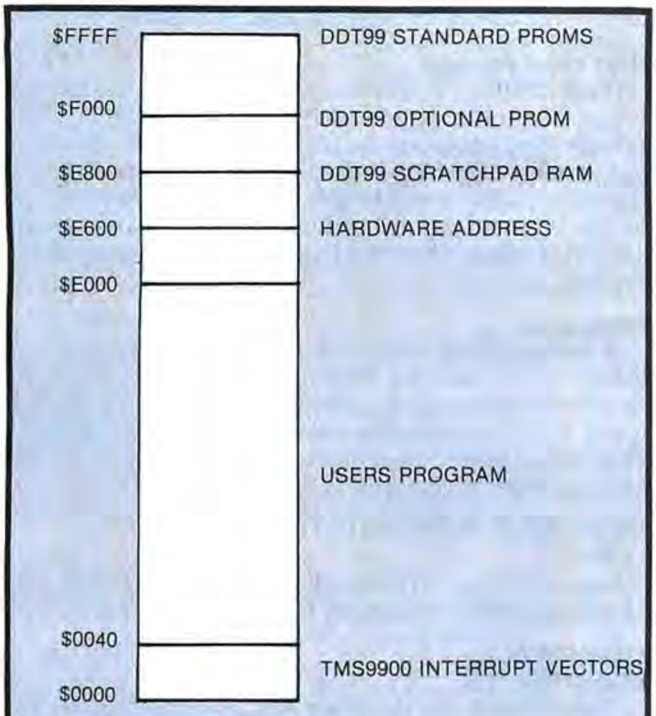

Figure 2.

USING INTERRUPTS

The user program may use any interrupts except LOAD (which is in PROM at $FFFC and used by DDT99 V1.2) and Interrupt 1, which is reserved exclusively for the address breakpoint latch (value for DDT99 V1.2 is $E604,$F6E6). Should the user program alter the interrupt vector at Address 4 through 7, single step, track, jump, and breakpoint capabilities are immediately incapacitated. Should these instructions be attempted while the interrupt address is altered, the program will transfer to an address other than that to which it should, with all bets off on results and effects of user program in RAM.

In addition, should the user's program alter the Interrupt 2 address, then the <RUBOUT> will no longer function to terminate the execution of a user's program. However, upon successful compare of the breakpoint latch, the vector for the terminal will be restored.

There is also one other exception that must be noted. You must not set the mask to less than 1 in any case. If the mask is lowered to 0, the breakpoint latch will be disabled, killing the breakpoint capability and hence S, J, and T commands. Should this occur, the interrupt will hit as soon as the user's program raises the mask to 1 or higher. As a precaution against this, whenever DDT99 turns control over to the user's program, (via G, or at each step of S, T, and J) a check is made of the user's status. If the interrupt mask is set to zero, DDT99 forces it to one. This does not prevent a routine from lowering the mask in an instruction between the starting and breakpoint locations, however.

With these considerations excepted, all interrupt handling is identical to a system with no DDT99 V1.2 monitoring in progress.

RETURNING FROM A PROGRAM

If a user program has an end condition that should transfer back to DDT99 V1.2, the user program should do a branch to $F000. This address will remain the same on all future versions and will issue a <CR>/<LF>, followed by the DDT99 prompt.

Causing A System Reset

If the user wishes to simulate a power-up of DDT99 V1.2, he should do a branch to location $F004. This is equivalent to typing command 'X' in DDT99 V1.2. This does a complete reinitialize of all pertinent variables in DDT99 V1.2 but does not reset the UARTs.

COMMAND SYNTAX NOTATION

Notation conventions used in command specifications and examples throughout this article are listed below.

NOTATION	DESCRIPTION
BOLDFACE CHARACTERS	boldface characters must be entered exactly as shown
ORDINARY CHARACTERS	ordinary characters (i.e., not boldface) identify elements that must be replaced with user-selected values
$	when not used in the context of a debugger command, the dollar sign indicates a hexadecimal string.
<>	a word or words enclosed in the symbol pair <> stands for an entity that cannot be printed directly, or which is otherwise representable only by a phrase (i.e., the symbol <**CR**> replaces the phrase 'carriage return', and stands for the ASCII characters whose hexadecimal value is $0D).
<**HEX**>	hexadecimal input from terminal. Anywhere from 0 to 4 characters. (0 characters yields value of zero).
<**ALT MODE**>	the character produced by the 'ALT mode' key on the terminal (ASCII $7D)
<**BACKSPACE**>	the character produced by the 'BACKSPACE' key of the terminal (ASCII $08), this is the same as a <**CONTROL-H**>
<**CONTROL-C**>	the character produced by holding the 'CONTROL' key down while typing a 'C' (causing ASCII $03). Also called 'ETX'.
<**CONTROL-D**>	the character produced by holding the 'Control' key down while depressing the 'D' (ASCII $4)
<**CONTROL-H**>	the character produced by holding the 'Control' key down while typing an 'H' (causes ASCII $08). This is the same as the <**BACKSPACE**>.
<**CONTROL-P**>	the character produced by holding the 'Control' key down while typing a 'P'. (ASCII $10)
<**CONTROL-R**>	the character produced by holding the 'Control' key down while typing an 'R'. (ASCII $12)
<**CONTROL-T**>	the character produced by holding the 'Control' key down while typing a 'T' (ASCII $14)
<**CONTROL-U**>	the character produced by holding the 'Control' key down while typing a 'U' (ASCII $15)
<**CR**>	the carriage return (ASCII ($0D)
<**LF**>	the line feed (ASCII ($0A)
<**RUBOUT**>	the rubout character (ASCII $7F)
MSA	starting address for memory inspection or change created via, or generated by an instruction. It is listed with each instruction that uses it, though it need not be explicitly stated if previously declared or generated.

MEA ending address for memory inspection or change treated the same as MSA, except that it is explicitly created by following a number with A;

UTA User Transfer Address. Explicitly generated by command — or program generated as the result of any breakpoint being hit during execution of user program (BP following G, or single step via **S**, **T**, OR **J**)

, defines preceeding number as the starting address **(MSA)** for any subsequent commands until redefined

; defines preceeding number to be the ending address **(MEA)** for any subsequent commands requiring multiple addresses, until redefined.

- defines the preceeding number as a transfer address **(UTA)** with which to transfer to the user's program. It is redefined upon each breakpoint interrupt occurrence to be the address that would continue execution.

DEBUGGING MODES

DDT99 V1.2 does not have a 'LINE MODE'. All commands are in immediate mode and are executed as typed.

COMMAND MODE

In this mode, which is the power-up default, DDT99 V1.2 controls the full operation of KRONOS, memory I/O, and user program execution. The prompt character in this mode is a **'?'**. 0 through F and all keys indicated in command summary are valid in this mode. Any other key is ignored. Numeric input may be backspaced only up to the last non-digit command — commands cannot be backspaced over since they are executed immediately when typed.

ASSEMBLY MODE

In this mode, all input is expected to be assembly mnemonic which is translated and input into memory at the specified address. Prompt for this mode is **'XXXX A-'**, where XXXX is the next address to be filled by the assembly input. **'NOASM'** will be printed with an invalid mnemonic, and the same address will be reprompted. Improper arguments will sometimes (but not always) be caught with the same message.

KRONOS MODE

In this mode, the microprocessor is transparent, and the box appears as a dumb terminal directly tied to the host computer system. Only a very few commands are accepted in this mode (those that allow return to command mode and control of a downloaded program). Error correction in this mode is dependent on the host computer program in control (scribe, edit, etc.).

REGAINING CONTROL

Should you type in a command that causes the system to run away, there are three methods to regain control. Runaway systems may result from typing excessively long loops in print or trace statements, setting a breakpoint and then going to an area that never allows the breakpoint to be reached, etc.

Stopping Execution

In most instances, hitting the <**RUBOUT**> key will terminate the execution of the current comand and return to command mode. This will work with all DDT99 V1.2 controlled operations and with the execution of any user program so long as Interrupt 2 has not been redefined by the user. A **P** may be typed upon receipt of the **?** prompt, to give full status of program that was terminated.

Next Level Attempt

If the <RUBOUT> does not work, the next best way to regain control is via the **INTERRUPT 1 BUTTON,** if the system is so equipped. Note that this has the advantage over a panic stop in that if it is followed with a **T**, **S**, or **J** command, a trace will begin, picking up at the location of the program when the button was hit. This allows easy determination of the loop that was hanging up the system.

Panic Stop

If neither of the former two approaches work, due to the destruction of the interrupt vectors in RAM, or the absence of a Interrupt 1 button in your system, the last resort (short of power-down) is to hit the **LOAD BUTTON.** This does a power-up sequence, reinitializing all UARTs and variables as required in such a condition.

DEBUGGER INPUT CONTROL

<**CR**>

Carriage return erases all input since the last valid command and is equivalent to four backspaces.

<**BACKSPACE**>
<**CONTROL-H**>

These characters (both are ASCII $08) will delete the prior character **back to the last valid command.** Note that once a command has been entered it cannot be deleted, except by retyping.

RUNON CHARACTERS

In numerical entry, only the last four numerals entered are kept. Thus, you may continue typing until the last four numbers are valid, making the error fall off the high end, effectively. Thus, typing **1234560010Q** would print the HEX contents of $10 words, since the 123456 would 'fall off' the high end.

DEBUGGER MODE CONTROL

Power up, or depressing of the LOAD button causes the DDT99 V1.2 to come up in command mode.

<**ALT MODE**>

When in command mode, <**ALT MODE**> will toggle the user between ASM99 and command mode. When in KRONOS mode, <**ALT MODE**> will switch the user back to command mode.

Thus, <**ALT MODE**> will switch the user from any non-command mode to command mode.

K
/

Either **K** or **/** will switch the user from command mode to KRONOS mode. Note that there is no direct path from ASM99 mode to KRONOS mode. You must go through command mode to get between KRONOS and ASM99 modes. Note also that the act of logging on (such as would occur by dialing up on a modem) automatically switches the user to KRONOS mode when the date is printed by KRONOS. If you already have KRONOS on in the background, typing either **K** or **/** will switch you back to talking to KRONOS again.

This mode yields control to the host computer (a CDC6400 operating under KRONOS). The prompt character in this mode depends on the program being used on KRONOS (edit, scribe, etc.). Only a limited subset of characters is acted upon by the DDT99 V1.2 program when in KRONOS mode. This limited set allows KRONOS to control a download sequence into RAM, and to allow either KRONOS or the user to switch back to DDT99 V1.2 command mode at will.

COMMAND MODE INSTRUCTIONS

MEMORY OUTPUT

MSA,KQ — Output HEX contents of K memory addresses starting at MSA. All lines except the first are lined up with the first address evenly divisible by $10, and $10 bytes per line. The first line will begin with the word given as MSA (note that an odd address will be decremented for MSA to create a valid word address).

MSA,KL — List K instructions beginning with that located at MSA. Note that in this mode, all words are listed as they would execute if jumped to. (That is, the disassembler tries to fit the data to a valid instruction before deciding it is data.) Words that are invalid opcodes are listed as **'WRD XXXX'**, where XXXX is the HEX contents of the address. MSA is incremented to point to the next instruction following the list so that **KL** will continue listing the next K instructions.

P — Print status of user's program and all user registers. This is automatically done when a breakpoint has been hit, and allows the user to inspect the progress at any time he wishes. This printout also includes the status of the breakpoint, if on.

<**CONTROL-P**> — See Paper Tape Commands

MEMORY SET COMMANDS

MSA,<HEX> — Insert hexadecimal value <HEX> in location MSA, and increment MSA. Note that once MSA is given, the user may type in:
WORD1'WORD2'WORD3'. . .with each word going into successive addresses.

MMMM,**R**N — Set user register N to MMMM
Note that this can be strung. For example, to set registers 1,5,7, and 0 to 1234, the following command would be used:
1234,R1R5R7R0

MSA,MEA;
<HEX>**Z** — Set memory range MSA to MEA with HEX value <HEX>. Note that the following will zero out an area of memory: **MSA,MEA;Z**

<**CONTROL-R**> — See Paper Tape Commands

The dash (-) character defines a transfer address **(UTA)** for DDT99 V1.2 to use in executing a user program.

MMMM-N**G** — Go to user program at address **MMMM.** Note that if no breakpoint is set, this command has set the program free. Termination can still occur via <**RUB-OUT**> assuming that Interrupt 2 is not altered by the user's program.

More commonly, a breakpoint will be set at some desired inspection point before the **G** command is invoked. The breakpoint address will be passed **N** times before stopping execution and printing status, thus allowing a status check every **n**th time through a loop. When breakpoint has been acknowledged, if **G** is typed again, the program will continue at the point that it was interrupted. Thus, if a breakpoint is set in a loop, each **G** command will cause another turn through the loop.

NOTE:
TMS9900 does not recognize an interrupt during a BLWP or XOP instruction. Thus, if such an instruction is traced, two instructions will be executed, rather than the single instruction expected. (The same is true for interrupts, including RESET and LOAD.)

MMMM-K**T** — Trace K instructions starting at **MMMM.** Each instruction will be traced, including all subroutine jumps. No problem will occur even if the user program uses some of the DDT99 V1.2 utility routines. At the end of each instruction execution, the terminal will list on a single line
LAST ADD-- LAST INSTR-- REGISTER CHANGE
Note that only a register that has changed as a result of the instruction will be printed. After K instructions have been traced, DDT99 V1.2 waits for further instructions. If a space is typed, it will trace one more instruction and again wait, ad nauseum. If a <CR> is typed, DDT99 V1.2 will return to command mode. Any other command will be executed as expected for command mode.

MMM-K**J** — Same as trace instruction above, except that all **BL** and **BLWP** instructions are skipped in tracing (executed but not traced until they return). Note that if several BL and BLWP instructions are in tandem, the entire sequence will be skipped due to the interrupt handling nature of the processor. Note also that if the subroutine does a non-standard return, DDT99 V1.2 control will be lost (since the breakpoint will have been set to the word following the call).

MMMM-K**S** — Single step K instructions starting at **MMMM.** This execution is identical to the **T** instruction, except that all 16 registers are printed out after every instruction.

MMMM**N** — **N**O PASS. If address MMMM is reached during any step mode &S,T, or J) the trace will terminate, giving control back to DT99 V1.2 command mode. This is useful for setting the **N**O PASS at the return point of a subroutine to trace the entire subroutine with an unknown number of steps in execution.

MISCELLANEOUS INSTRUCTIONS

MSA,**I** — Set interrupt to address MSA. Note that all interrupts must be even addresses to ever occur. Thus, if an odd address is set here, the breakpoint is effectively turned off.

MSA,MMM= — HEX arithmetic. DDT99 V1.2 prints --- SUM(HEX), SUM(DECIMAL), DIFF.(HEX), DIFF.(DECIMAL)

X — Reset all flags and simulate a power up condition. This will set **BREAKPOINT = NONE, KRONOS IS OFF,** and **NO**

PRIOR INTERRUPT is recognized as having occurred.

MMMM**W** Set user's **W**orkspace pointer to MMMM.

MMMM**O** Set user's status register to MMMM.

MMMM<**CONTROL-D**>
Sets delay to be given after each <LF> is sent to terminal. (Power up defaults to no delay) Some refresh terminals need extra null time to allow screen scrolling with the result of missing data at the start of each line if this delay is not available.

SUPPLIED OPTIONAL COMMANDS

NNNN,XXXX;KKKKM
Walking ones memory test. Perform a walking ones RAM test on the address block from NNNN to XXXX. A loop delay of approximately 6 * KKKK microseconds between the write and read cycles is allowed to test refresh circuitry.

n**H** Turn on AUTO-**H**ARDCOPY if N<>0. Turn off AUTO-**H**ARDCOPY if N = 0. Hardcopy implemented here is Tektronix 4610.

U **U**PLOAD. This is a toggling command. The first time received, it will switch into upload mode sending **HALF** <**CR**> to switch terminal into half duplex. Upon KRONOS prompt of >, DDT99 V1.2 will send **NEW,A1** <**CR**> to open a file called A1 for text input. Upon the KRONOS prompt of >, DDT99 V1.2 will send **TEXT** <**CR**>, placing KRONOS into an input text mode. Upon <**LF**> from KRONOS, DDT99 V1.2 goes back to normal command mode, except that all information appearing on the terminal is now also being sent to KRONOS as a text string to be stored in File A1.

Next time the **U** is commanded, DDT99 V1.2 will terminate the KRONOS input mode, pack A1, replace A1 as a permanent file, return KRONOS to full duplex, and return to command mode. The user may now switch to **K**RONOS mode (Command **K**) if desired and type **PRINT,F = A1** to receive a computer printout of the entire DDT99 V1.2 terminal session, including any program listing, memory dumps, program tracing, etc.

N**V** **V**ERIFY TIMING. This is a toggle command putting a user into (or out of) **V**erify time mode.

If N = 0 and the user is not timing a program, a 'clock' starts at zero and all further traced instructions are timed. If N = 0 when in timing mode, the mode is terminated with the printout (in decimal) of the clock cycles and memory accesses required to execute to test program.

If N<>0 then either the **V**erify mode is entered without altering the previous contents of the clock, or (if already in Verify mode) the decimal count of the clock cycles and memory accesses are printed without changing the status or clock value.

Only those instructions that are traced directly will be counted in the clocks. Thus, if an entire sequence is desired to be timed, either the **S** or **T** commands must be used from start to finish (placing the **N** command at the departure point is helpful here). If, however, only a mainline is wanted, the **J** command allows timing only to be affected by the mainline instructions.

CAUTION:
Note that the timing given from this instruction is from a table, not actually measured by any hardware. Those instructions that have a variable length have been assigned a 'normal' execution time and memory access number. These instructions include MPY, DIV, and all conditional jumps. The results from this command are intended for use in trimming subroutine execution speeds and approximating execution times for external interfaces. It should be be relied on for absolute accuracy when required to exactly match external hardware, though.

MMMM**$** Converts from HEX to decimal and from decimal to HEX. Conversion to decimal assumes positive number (i.e., addressing numeric mode). Conversion to HEX assumes MMMM is valid in decimal and will be a bogus number if any digits A through F are present.

<**CONTROL-P**> See Paper Tape Support

<**CONTROL-R**> See Paper Tape Support

PAPER TAPE SUPPORT COMMANDS

Note that these are part of the supplied optional command set and do not fit in the minimal 2K monitor.

CAUTION:
My system does not have paper tape hardware. Thus, these commands have only been tested via simulation, and may still have some bugs.

MMMM,NNNN;<**CONTROL-P**>
(OPT) Punch binary paper tape of memory contents from address MMMM and NNNN. Both addresses will be truncated to even word boundaries before punching tape. One large block is sent with only a single checksum for the entire dump. The format is:
1) Block byte count (2 bytes). Includes address.
2) Starting address (2 bytes). Always even.
3) (N-2) bytes of data.
4) Longitudinal check sum (2 bytes). Obtained by register (starting at zero) XOR with each full data word. Reading algorithm would load byte; SLA 8; SOC with next byte read; and XOR to checksum register.
5) A binary 'Z' on tape to signal read routine that paper tape is complete. ($FF,$01,$02,$04,$08,$10,$20,$40,$-80,$FF)

6) 50 null characters form a leader and trailer.

<CONTROL-R> **(OPT)** **R**ead Binary Tape. Will read tape in format produced by **<CONTROL-P>**. Note that multiple blocks may be read, though, and that you are not constrained to one large block on read. Termination of the read mode is done upon reading a binary 'Z' on the tape, immediately following a checksum $FF,$01,$02,$04, $08,$10,$20, $40,$80,$FF).

KRONOS MODE INSTRUCTIONS

<CONTROL-T> Begin Downloading Procedure. This is sent by the KRONOS downloading routines at the start of a line of downloaded code. It must be followed immediately with the address at which to store the following code, then the number of bytes of code in this string, followed by the XOR checksum for the string. The string of hexadecimal ASCII code is then sent by KRONOS, followed by '?'. DDF99 V1.2 will respond with **<SPACE>** **<CR>** if the string was received error-free, or with **R<CR>** if there was an error. It expects KRONOS to repeat the line in the latter case, though will not error-out if KRONOS fails to do so.

<CONTROL-U>
<NAK> Terminate Download. This is sent by the KRONOS-resident download program to inform DDT99 V1.2 that the downloaded portion is complete. DDT99 V1.2 returns to normal KRONOS mode after receiving this command.

<CONTROL-C>
<ETX> Switch from KRONOS to DDT99 V1.2 Command Mode. This is the same as typing **<ALT MODE>** while in KRONOS mode, but is intended to be placed in a precedure file following a download for those who wish to automatically return to command mode following a download.

ASM99 MODE INSTRUCTIONS

MSA,<ALT MODE>

This will transfer you into ASM99 mode if in command mode, or into command mode if presently in ASM99 mode. Note that the ASM99 will place the next instruction typed into the address specified by MSA.

This is a one-line assembler and will not accept symbolic references to lines. It expects the following —

Mnemonic — Any of the standard TI9900 instruction set mnemonics may be used.

WORD XXXX — will place XXXX directly in memory.

FCC XXX. . . — will place the remaining ASCII string **UP TO** <**CR**> in memory in ASCII form (backspace may be used to edit line here, as throughout ASM mode). A zero byte is automatically added to the end of the text string, if necessary, to assure a word boundary for the next instruction.

<**CR**> — Terminates Assembly Line. Line will be interpreted and assembly code inserted in RAM, with MSA incremented appropriately for the code assembled. If the code could not be interpreted, ASM99 will print **NOASM**, followed by reprompting for the same address.

If a <CR> is the first non-space character input, the address counter will be incremented one word with no change in RAM, to allow passing over existing code.

R — **All register** references must begin with an **R**. Only R0 through RF will make sense.

Delimiter — Spaces and commas are delimiters. All superfluous spaces are ignored, as are many comments following the last valid field.

Addresses — All address references should be to the absolute address desired in HEX. On jump instructions, ASM99 will compute the proper offset. If the jump is not within the range of the instruction, ASM99 will print **NOASM** and reprompt for the same address.

Line Length — Max line length for any assembly line is 16 characters. If more characters are typed, ASM99 will respond with **NOASM** and reprompt for the same address.

OPTIONAL COMMAND

Several instructions are included under 'Supplied Optional Commands' and indicated at (OPT) in the command summary. These are resident in a PROM addressed at $E800 and may be included in the version of DDT99V1.2 used. They may also be left out completely with no ill effects, other than the loss of those commands. The optional table resident in that PROM may be expanded or completely revised as follows:

DDT99 V1.2 was written with the explicit idea of expansion and flexibility to handle different programmer preferences. It is therefore possible to redefine any of the instructions in the command set, or to add new instructions that do not currently exist, without changing the standard 2K of PROMs as herein described.

This is done by creating an optional command table at address $E804, which is checked before the standard DDT99 V1.2 table is checked. If a key is struck which has been defined in the optional command table, DDT99 V1.2 will do a BLWP indirect through the table as specified. When your routine does a RTWP, you will be back in command mode and a prompt will be sent.

The first three lines of the optional command table are fixed and **must** be exactly as follows:

```
ORG $E804
WORD $AAAA
WORD $5555
```

This, in essence, says 'Hello' to DDT99 V1.2, telling it that an optional command table exists. The rest of the table follows the format shown:

```
WORD 'V
WORD WPV
WORD EXECV
•
•
•
WORD $FFFF
```

Where, in this case, **V** is the terminal key you wish to execute on; **WPV** is the workspace pointer you wish to

use to execute your program (see note below); and **EXECV** is the address of the program you have written in this PROM to handle the key selected. This table can continue indefinitely, defining as many keys as desired, but **must** terminate with **WORD $FFFF**. If it does not, DDT99 V1.2 will search through your 'table' until it finds a match for key input, or hits a $FFFF in memory.

VARIABLES USED

There are several variables used extensively in DDT99 V1.2, which you will need to know about if you wish to write optional commands for your own use. A listing of DDT99 V1.2 has all variables in the second named block.

NOTE:

Any persons changing DDT99 in the future — do not change the order of any variables in the variable definition block. Any new variables required should be appended to the end of the variable block. If this is not done, any 'optional command' PROMs in existence will not be compatible with the new version and some standard commands relying on the order will not work properly.

The mainstream program uses **WPDDT99** as its workspace pointer. **USERWP** is the pointer used by user's program and should not be altered by any optional program. **WPINT2** and **WPINT3** are interrupt handler workspace pointers and are dangerous for any other use. **WPBUG2** and **WPBUG3** are both available for optional program use. **WPHOLD** is used as input buffer in ASM99 and as register compare buffer in **J**, **T** and **S** command execution.

Table 1. Variable Definition

	0000	R0	EQU	0	
	0001	R1	EQU	1	
	0002	R2	EQU	2	
	0003	R3	EQU	3	
	0004	R4	EQU	4	
	0005	R5	EQU	5	
	0006	R6	EQU	6	
	0007	R7	EQU	7	
	0008	R8	EQU	8	
	0009	R9	EQU	9	
	000A	R10	EQU	10	
	000B	R11	EQU	11	
	000C	R12	EQU	12	
	000D	R13	EQU	13	
	000E	R14	EQU	14	
	000F	R15	EQU	15	
	E600	RAM	EQU	$E600	LOCATION OF WP RAM BLOCK
	0A0D	CRLF	EQU	$0A0D	ASCII CARRIAGE RETURN-LINE FEED
	E600		ORG	RAM	
$E600	0002	INT2DAT	BSS	2	DATA FROM TERM OR KRONOS
$E602	0002	INTFLAG	BSS	2	BIT # On = INT # HIT
$E604	0020	WPDDT99	BSS	32	MAINLINE WP
$E624	0020	WPINT2	BSS	32	WP FOR INT2
$E644	0020	WPINT3	BSS	32	WP FOR INT3
$E664	0020	WPBUG2	BSS	32	SUPPORT ROUTINE WP
$E684	0020	WPBUG3	BSS	32	LARGE SUPPORT ROUTINE WP
$E6A4	0020	WPBUG4	BSS	32	DECODING WP
$E6C4	0020	WPBUG5	BSS	32	PROM-SAVING ROUTINES
$E6E4	0020	WPTRMNL	BSS	32	TERMINAL I/O WP
$E704	0020	USERWP	BSS	32	USER'S DEFAULT REGISTER SET
$E724	0042	WPHOLD	BSS	66	TRACE REGISTER COMPARE
$E766	0002	KRONOS	BSS	2	KRONOS ON = 1; OFF = 0
$E768	0002	USRWP	BSS	2	USER WP ON RETURN (W)
$E76A	0002	USRPC	BSS	2	USER PC ON RETURN (-)
$E76C	0002	USRST	BSS	2	USER ST ON RETURN (O)
$E76E	0002	BRKPNT	BSS	2	ADD. TO BP ON (I)
$E770	0002	BRKPASS	BSS	2	NUMBER OF TIMES TO PASS BP
$E772	0002	EDIT1	BSS	2	NUMBER TERMINATED BY , (MSA)
$E774	0002	EDIT2	BSS	2	NUMBER TERMINATED BY ; (MEA)
$E776	0002	TRACTYP	BSS	2	0 = ALL REG; -1 = JUMP; 1 = QUICK
$E778	0002	TRACPRN	BSS	2	SAME AS ABOVE ON PER INSTR.
$E77A	0002	COUNT	BSS	2	COMMAND COUNT (NUM.<COMMAND>)
$E77C	0002	TAB	BSS	2	CHAR. POSITION ON LINE
$E77E	0002	WORD1	BSS	2	REFER. SYMB. ADDRESS
$E780	0002	WORD2	BSS	2	SAME AS WORD1
$E782	0002	WORD3	BSS	2	SAME AS WORD1
$E784	0002	WORD4	BSS	2	SAME AS WORD1
$E786	0002	DLATMP	BSS	2	COUNTER FOR DELAY
$E788	0002	DLALOP	BSS	2	INTERNAL LOOP COUNTER FOR DELAY
$E78A	0002	LINE	BSS	2	LINE COUNT FOR PAGE (H)
$E78C	0002	DELATIM	BSS	2	DELAY LOOP COUNT AFTER <LF>
$E78E	0002	HARDCP	BSS	2	<>0 IF AUTO-HARDCOPY REQUESTED
$E790	0002	MASSMEM	BSS	2	<>0 IF UPLOAD ON (U)
$E792	0002	OPTIONS	BSS	2	<>0 IF OPTIONAL TABLES EXIST
$E794	0002	HALTADD	BSS	2	HALT ADDRESS FOR STEPPING (N)
$E796	0002	SPEED	BSS	2	CYCLES FOR EXECUTION (V)
$E798	0002	ACCESS	BSS	2	MEMORY ACCES. FOR EXEC. (V)
$E79A	0002	BUSY2	BSS	2	FLAG TO IGNORE TERM IN STEP

REGISTER 0 OF WP 1 WILL CONTAIN ANY NUMBER INPUT IMMEDIATELY BEFORE TYPING THE COMMAND YOU RECOGNIZED.

Table 2. Interrupt Handlers

LEVEL 1	**BREAKPOINT LATCH** Moves R13 TO USRWP ($E768) Moves R14 TO USRPC ($E76A) Moves R15 TO YSRST ($E76C) Resets Line Branches indirect through R0 — Note that R0 of WPDDT99 must have desired transfer address before INT1 is hit.
LEVEL 2	**TERMINAL** Places ASCII character in 'INT2DAT' ($E600) after clearing high 9 bits. Sets bit 2 of INTFLAG ($E602) Normal return via RTWP
LEVEL 2	**PAPER TAPE** Paper tape is in parallel to terminal and can be distinguished only by context. Normally, paper tape interrupts will occur only after a <CONTROL-R> command.
LEVEL 3	**KRONOS** Same as Level 2 except Bit 3 of INTFLAG is set.

SUBROUTINES

There are several subroutines that are used in the DDT99 V1.2 monitor that may be of occasional help for users of this system.

Table 3. Subroutines

ASCII	MOV NUMBER,R2 BL ASCII Convert HEX digit (rightmost 4 bits) in R2 to ASCII for later transmission to terminal.	$F568
BLANKS	BLWP BLANKS Print 2 spaces.	$F52A
CHKWORD	BL CHKWORD Word HERE (Used to print address and contents of memory reference) If 'HERE' is zero, do nothing and return. If 'HERE' is non-zero, print its value in HEX, followed by ' = ', and the value of the memory at that address (i.e., indirect value).	$F61E
DELAY	BL DELAY Word WAIT Delay for approximately 100 * WAIT microseconds	$F4E6
MESAG	BLWP MESAG FCC 'XXX' Even Word 0 Print ASCII message following call until a full word zero is encountered in string.	$F4FE
MESG1	BLWP MESG1 Word 'X Prints ASCII of 2 bytes following call (zero byte is not sent).	$F516
PADDINS	MOV INSTR,R0 BLWP PADDINS Print address R0 has and also print the decoded instruction at the address indicated by R0.	$F5AA
PINSTRC	MOV ADDRESS,R0 BLWP PINSTRC Print decoded instruction pointed to by callers R0.	$F792
PREGSTR	BLWP PREGSTR Print values of all registers at workspace pointed to by 'USRWP' ($E768).	$F858
PRINT	MOV NUMBER,R0 BLWP PRINT Prints R0 of calling routine as 4 HEX digits to terminal.	$F5E6
PRINT1	MOV NUMBER,R0 BLWP PRINT1 Print rightmost HEX digit of callers R0.	$F606
PRINT2	MOV NUMBER,R0 BLWP PRINT2 Print rightmost 2 digits of callers R0 to terminal.	$F612
PRINTD	MOV NUMBER,R0 BLWP PRINTD Prints R0 of callers routine in decimal, left justified. (Optional PROM)	$E990
PRINTS	MOV NUMBER,R0 BLWP PRINT Same as **PRINT**, except it adds 2 spaces after 4 digits.	$F5BE
PSTATUS	BLWP PSTATUS Prints HEX values of variables USRWP ($E768), USRPC($E76E), USRST($E76C), and BRKPNT if even ($E76E), labeling them as: I = XXXX PC = XXXX WP = XXXX ST = XXXX.	$F800
REGNUM	MOV NUMBER,R0 BLWP REGNUM Print 'RN', with N supplied by callers R0.	$F5CE
RETURN	BLWP RETURN Print <CR><LF>.	$F53C
TABOVR	BL TABOVR Word TABPOS Tab to position 'TABPOS' by printing spaces. This assumes that 'TAB' ($E77C) has current character position on line.	$F550
TRMSEND	LI R2,'X BLWP TRMSEND Print right byte of callers R2, checking for auto-hardcopy and upload.	$F4C2
TSD	LI R2,'X BL TSD Send right byte of R2 to terminal.	$F48C
UNASCII	MOV ASCII,INT2DAT BLWP UNASCII Return HEX number in INT2DAT ($E600) of ASCII value passed to routine in same variable.	$F57C

FLOW CHARTS

The following flow charts may assist those who wish to modify this program for their own use. For obvious reasons of space, the entire program with each of its subsections has not been charted here. The few examples chosen will show the programming approach used in this monitor and will aid in altering the most likely required areas.

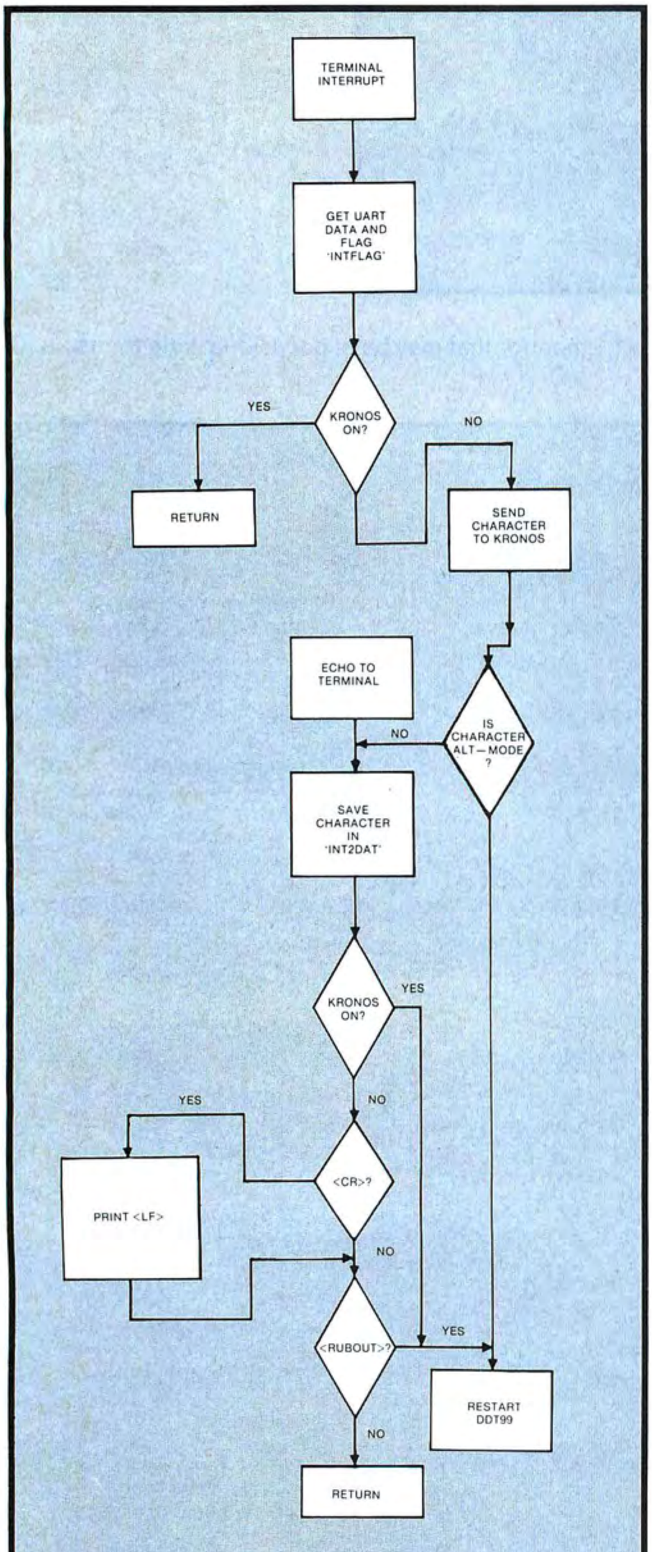

Figure 3. Command Receipt Flow Chart

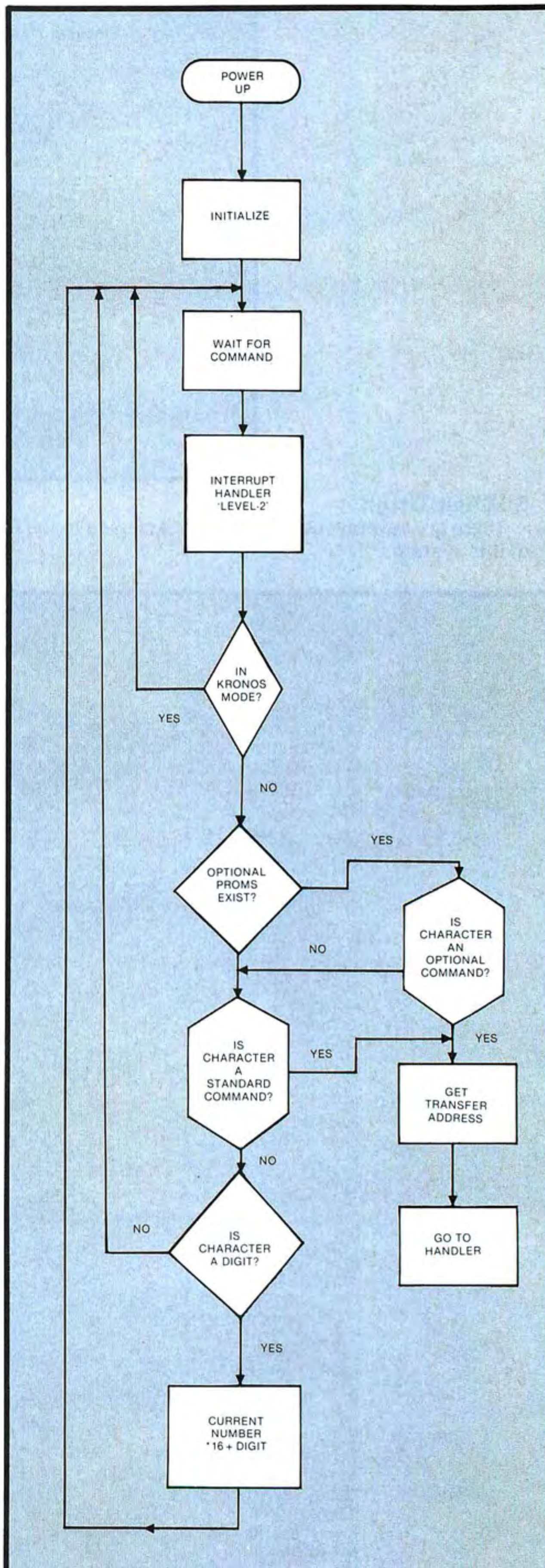

Figure 4. Process Commands Flow Chart

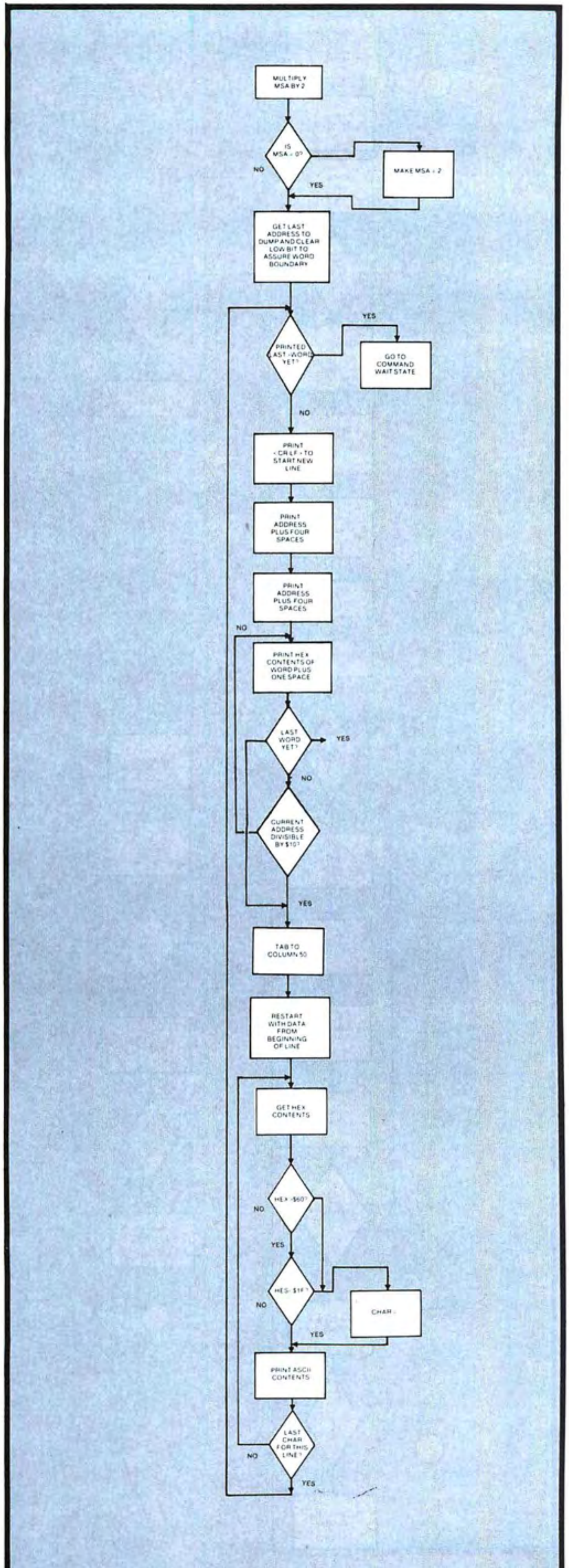

Figure 5. Process 'Q' Command Flow Chart

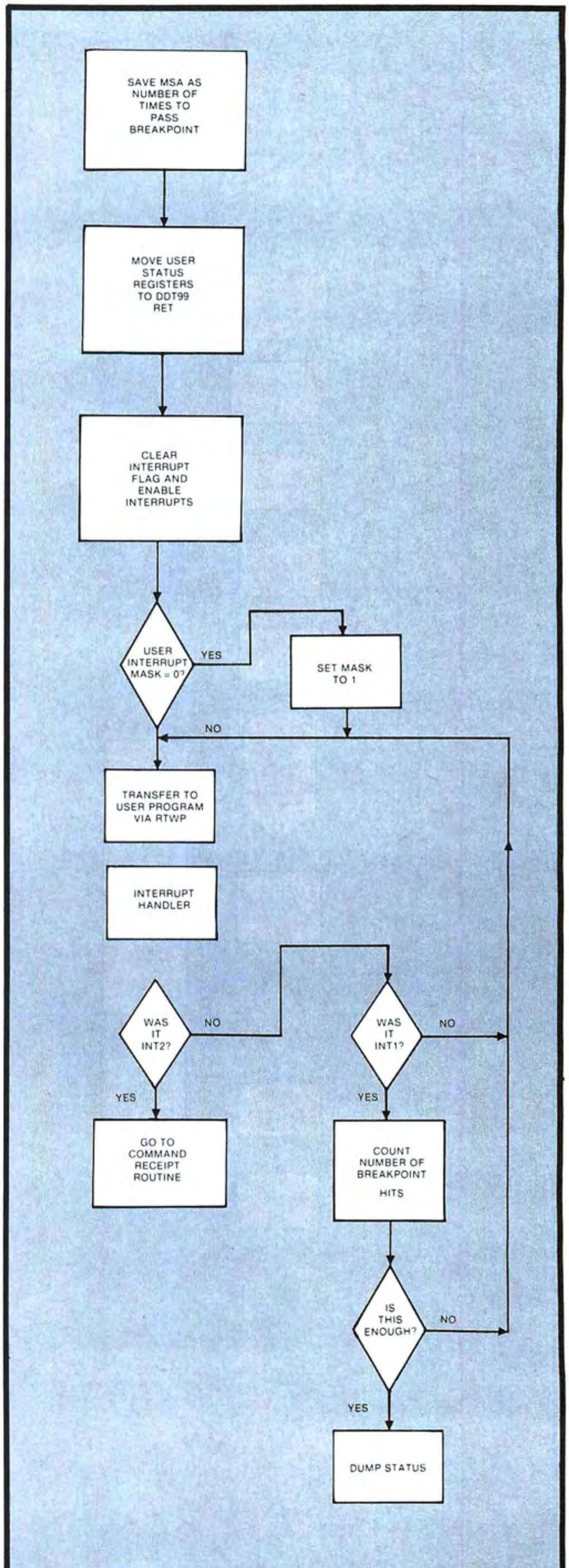

Figure 6. Process 'G' Command Flow Chart

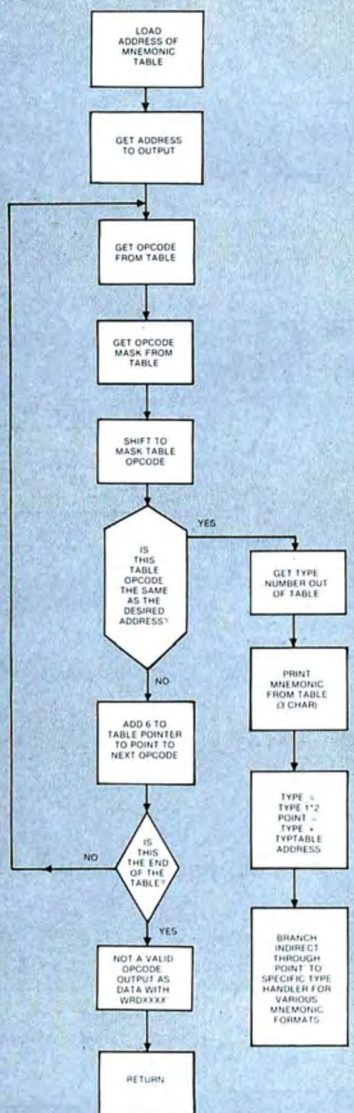

Figure 7. Print Instruction Mnemonics Flow Chart

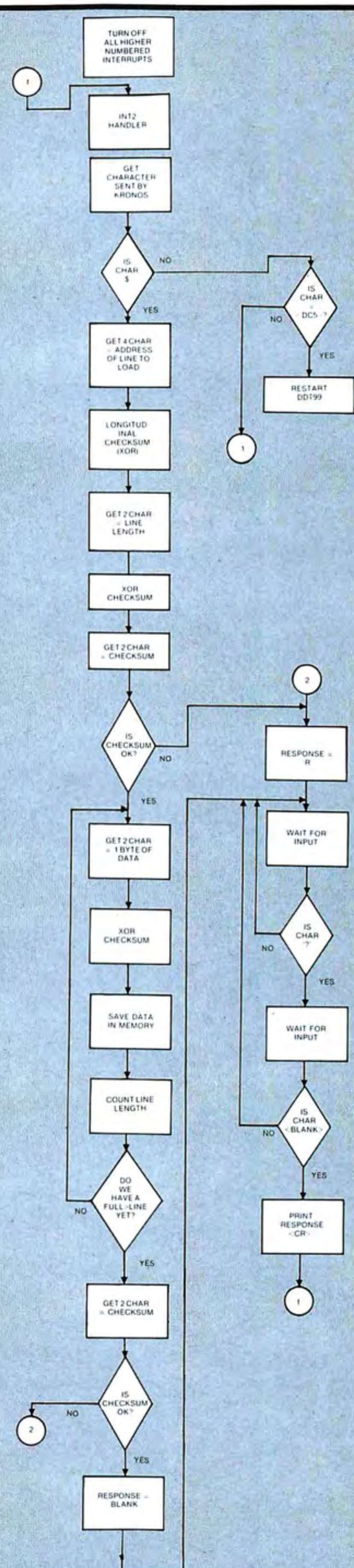

Figure 8. Download Flow Chart

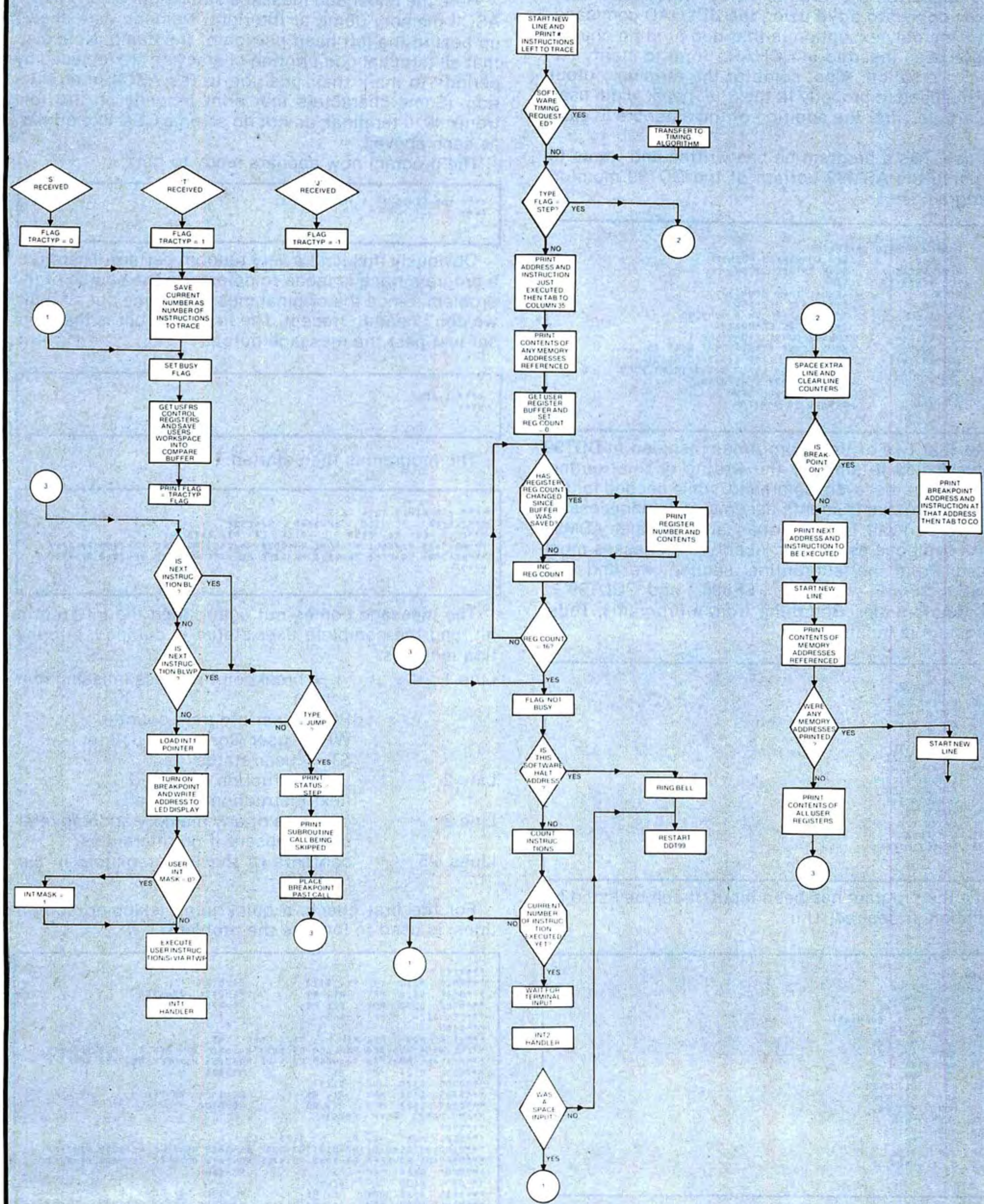

Figure 9. Trace Handling Flow Chart

EXAMPLES

Here is an example of the use of DDT99 V1.2. This program generates a few (very few, I might add) pseudo-random numbers. All lines starting with '***' are exactly as they appear on the terminal screen (they were automatically copied to a file using the **UPLOAD** command, in fact). The only exception is that non-printing characters have been inserted in <CHAR> form to clarify terminal conversation. Also, some of the terminal output has been edited to properly fit the 8½" paper width used in this article, after the addition of the asterists in each line.

The user has a program he has written and wants to input using the ASM99 portion of the DDT99 monitor. The program is:

```
*       RANDOM NUMBER GENERATOR
        LWPI 40            SET WORKSPACE POINTER
        BLWP MESAG         GIVE INTRODUCTION
        FCC 'THIS IS A TEST'
        EVEN               ASSURE WORD BOUNDARY
        WORD 0             TERMINATE MESSAGE
        LI R3,8            SET COUNTER FOR 8 NUMBERS
        LI R1,123          INITIALIZE GENERATOR
LOOP    MPY R1,R1          SQUARE NUMBER (UNSIGNED)
        MOV R2,R0          MOVE LEAST SIGNIFICANT WORD TO ...
        BLWP PRINT1        ... PRINT LEAST SIGNIFICANT DIGIT
        MOV R2,R1          RUN LOOP ON LEAST SIGNIFICANT WORD
        DEC R3             COUNT DIGITS GENERATED
        JNE LOOP           CONTINUE TILL ZERO
        B DDT99            RETURN TO MONITOR
```

Note that two of the subroutines included in DDT99 V1.2 are called to simplify the writing of this routine. Note also that the 'even' command, while needed for the standard Texas Instruments assembler, is unnecessary in ASM99 (and will, in fact, not assemble). Since ASM99 is not a symbolic assembler, absolute addresses must be used. From the 'subroutine' section, we find that 'MESAG' = $F4FE, 'PRINT1' = $F606, and 'DDT99' = $F000 (found under 'Returning from a Program'). Thus, the program is input:

```
***? 100,<ALT MODE>
***0100  A-LWPI 40
***0104  A-BLWP F4FE
***0108  A-FCC THIS IS A TEST ,
***0116  A-WORD 0
***0118  A-LI R3,8
***011C  A-LI R1,123
***0120  A-MPY R1,R1
***0122  A-MOV R2,R0
***0124  A-BLWP F606
***0128  A-MOV R2,R1
***012A  A-DEC R3
***012C  A-JNE 120
***012E  A-B F000
***0132  A-<ALT MODE>
***?
```

Once the program has been input, it can be listed for verification, if desired. Thus:

```
***? 100,11L
***0100  LWPI  0040
***0104  BLWP  F4FE
***0108  SZCB  R8, *R1
***010A  SZC   *R3, 2049(R5)
***010E  SZCB  4120, RC
***0112  SZCB  R5, *R1
***0114  SZCB  *R4, RD
***0116  WRD 0000
***0118  LI    R3, 0008
***011C  LI    R1, 0123
***0120  MPY   R1, R1
***0122  MOV   R2, R0
***0124  BLWP  F606
***0128  MOV   R2, R1
***012A  DEC   R3
***012C  JNE   0120
***012E  B     F000
***?
```

Note that wherever possible, a valid opcode is generated with the list command (showing how the processor would interpret the data if it jumped to it). Imbedded data strings are often more clearly seen with the Memory Dump command:

```
***? 100,18Q
***0100  02E0 0040 0420 F4FE 5448 4953 2049 5320   ._C._A. ..THIS IS
***0110  4120 5445 5354 0000 0203 0008 0201 0123   A TEST.........#
***0120  3841 C002 0420 F606 C042 0603 16F9 0460   8A_A.. .._AB....._C
***?
```

Here the imbedded message stands out clearly in the ASCII memory dump at the right. Numeric data shows up best in the left hand portion of the dump. Note also that all terminal non-printing characters are replaced by periods to mark their position in the ASCII interpretation. (Some characters that print properly on the Tektronix 4010 terminal, do not do so on a CDC line printer, as seen above.)

The program now appears ready to run:

```
***? 100-GTHIS IS A TEST91111111
***?
```

Obviously this isn't a very random pattern. Therefore, a program trace is made to determine the source of the problem. Since the original message came out all right, we don't need to trace it. The first interrupt is therefore set just past the message output:

```
***? 118I
***?
```

The program is then started:

```
***? 100-GTHIS IS A TEST
***I=0118   PC=011C   WP=0040   ST=C002
***0118  LI  R3, 0008      011C  LI  R1, 0123
***R0=5401 R1=5401 R2=5401 R3=0008 R4=0815 R5=FBFF R6=2000 R7=FFFF
***R8=2804 R9=FEF8 RA=0000 RB=4AEE RC=2A04 RD=9FFC RE=2800 RF=FFFC
***?
```

The message comes out again, then the interrupt is hit, and the complete user status is dumped. Information includes:

Line 1	I = breakpoint address (missing if inactive)
	PC = user program counter
	WP = user workspace pointer
	ST = user status
Line 2	last instruction executed
	next instruction executed
Line 3	contents of any memory address referenced (absent if no references)
Lines 4-5	contents of the user registers in current WP

For the first check, a quick jump (skipping subroutines) is used to localize the problem:

```
***?10J
***0010  011C  LI   R1, 0123          R1=0123
***000F  0120  MPY    R1, R1          R1=0001  R2=4AC9
***000E  0122  MOV    R2, R0          R0=4AC9
***SB- 0124  BLWP  F6069
***000D
***0128  MOV    R2, R1       012A  DEC    R3
***R0=4AC9 R1=4AC9 R2=4AC9 R3=0008 R4=0815 R5=FBFF R6=2000 R7=FFFF
***R8=2804 R9=FEF8 RA=0000 RB=4AEE RC=2A04 RD=9FFC RE=2800 RF=FFFC
***000C  012A  DEC    R3              R3=0007
***000B  012C  JNE    0120
***000A  0120  MPY    R1, R1          R1=1508  R2=0101
***0009  0122  MOV    R2, R0          R0=0101
***SB- 0124  BLWP  F6061
***0008
***0128  MOV    R2, R1       012A  DEC    R3
***R0=0101 R1=0101 R2=0101 R3=0007 R4=0815 R5=FBFF R6=2000 R7=FFFF
***R8=2804 R9=FEF8 RA=0000 RB=4AEE RC=2A04 RD=9FFC RE=2800 RF=FFFC
***0007  012A  DEC    R3              R3=0006
***0006  012C  JNE    0120
***0005  0120  MPY    R1, R1          R1=ABF6  R2=ECA1
***0004  0122  MOV    R2, R0          R0=ECA1
***SB- 0124  BLWP  F6061
***0003
***0128  MOV    R2, R1       012A  DEC    R3
***R0=ECA1 R1=ECA1 R2=ECA1 R3=0006 R4=0815 R5=FBFF R6=2000 R7=FFFF
***R8=2804 R9=FEF8 RA=0000 RB=4AEE RC=2A04 RD=9FFC RE=2800 RF=FFFC
***0002  012A  DEC    R3              R3=0005
***0001  012C  JNE    0120
***?
```

In this mode:

Col. 1	number of instructions left to trace according to command
Col. 2	address of instruction just executed
Col. 3	mnemonic of instruction just executed
Remainder	contents of any registers that changed as a result of that instruction

Note that **SB-** indicates a subroutine call that was executed, but not traced. A full status dump is always done after a blanked subroutine call. In this case, the call to $F606 (PRINT1) printed a digit, which appears concatonated to the instruction.

If more complete information is wanted, a full-blown single step can be used instead:

```
***?10S
***0010
***0120  MPY   R1, R1        0122  MOV   R2, R0
***R0=ECA1 R1=0A89 R2=3D41 R3=0085 R4=0815 R5=FBFF R6=2008 R7=FFFF
***R8=2804 R9=FFF8 RA=0000 RB=4AEE RC=2A04 RD=9FFC RE=2800 RF=FFFC
***000F
***0122  MOV   R2, R0        0124  BLWP  F606
***F606=E664
***R0=3D41 R1=0A89 R2=3D41 R3=0005 R4=0815 R5=FBFF R6=2000 R7=FFFF
***R8=2804 R9=FFF8 RA=0000 RB=4AEE RC=2A04 RD=9FFC RE=2800 RF=FFFC
***000E
***0124  BLWP  F606          F60C  LI  R0, 0000
***R0=FFFC R1=FFFC R2=0030 R3=A026 R4=91C8 R5=7736 R6=6C77 R7=7E3F
***R8=4290 R9=0000 RA=FEC0 RB=F5E0 RC=884F RD=E684 RE=F874 RF=C00C
***000D
***F60C  LI  R0, 0000        F610  JMP   F5F0
***R0=FFFC R1=FFFC R2=0030 R3=A026 R4=91C8 R5=7736 R6=6C77 R7=7E3F
***R8=4290 R9=0000 RA=FEC0 RB=F5E0 RC=884F RD=E684 RE=F874 RF=C000
***000C
***F610  JMP   F5F0          F5F0  MOV   R1, R2
***R0=FFFC R1=FFFC R2=0030 R3=A026 R4=91C8 R5=7736 R6=6C77 R7=7E3F
***R8=4290 R9=0000 RA=FEC0 RB=F5E0 RC=884F RD=E684 RE=F874 RF=C000
***000B
***F5F0  MOV   R1, R2        F5F2  SRC   R2, 0
***R0=FFFC R1=FFFC R2=0030 R3=A026 R4=91C8 R5=7736 R6=6C77 R7=7E3F
***R8=4290 R9=0000 RA=FEC0 RB=F5E0 RC=884F RD=E684 RE=F874 RF=C000
***000A
***F5F2  SRC   R2, 0         F5F4  BL  F568
***F568=0242
***R0=FFFC R1=FFFC R2=0030 R3=A026 R4=91C8 R5=7736 R6=6C77 R7=7E3F
***R8=4290 R9=0000 RA=FEC0 RB=F5E0 RC=884F RD=E684 RE=F874 RF=C000
***0009
***F5F4  BL  F568          F568  ANDI  R2, 000F
***R0=FFFC R1=FFFC R2=0030 R3=A026 R4=91C8 R5=7736 R6=6C77 R7=7E3F
***R8=4290 R9=0000 RA=FEC0 RB=F5E0 RC=884F RD=E684 RE=F874 RF=C000
***0008
***F568  ANDI  R2, 000F       F56C  CI  R2, 000A
***R0=FFFC R1=FFFC R2=0030 R3=A026 R4=91C8 R5=7736 R6=6C77 R7=7E3F
***R8=4290 R9=0000 RA=FEC0 RB=F5E0 RC=884F RD=E684 RE=F874 RF=C000
***0007
***F56C  CI  R2, 000A        F570  JLT   F576
***R0=FFFC R1=FFFC R2=0030 R3=A026 R4=91C8 R5=7736 R6=6C77 R7=7E3F
***R8=4290 R9=0000 RA=FEC0 RB=F5E0 RC=884F RD=E684 RE=F874 RF=C000
***0006
***F570  JLT   F576          F572  AI  R2, 0007
***R0=FFFC R1=FFFC R2=0030 R3=A026 R4=91C8 R5=7736 R6=6C77 R7=7E3F
***R8=4290 R9=0000 RA=FEC0 RB=F5E0 RC=884F RD=E684 RE=F874 RF=C000
***0005
***F572  AI  R2, 0007        F576  AI  R2, 0030
***R0=FFFC R1=FFFC R2=0030 R3=A026 R4=91C8 R5=7736 R6=6C77 R7=7E3F
***R8=4290 R9=0000 RA=FEC0 RB=F5E0 RC=884F RD=E684 RE=F874 RF=C000
***0004
***F576  AI  R2, 0030        F57A  B   *RB
***R0=FFFC R1=FFFC R2=0030 R3=A026 R4=91C8 R5=7736 R6=6C77 R7=7E3F
***R8=4290 R9=0000 RA=FEC0 RB=F5E0 RC=884F RD=E684 RE=F874 RF=C000
***0003
***F57A  B   *RB           F5F8  BLWP  F4C2
***F4C2=E5E4
***R0=FFFC R1=FFFC R2=0030 R3=A026 R4=91C8 R5=7736 R6=6C77 R7=7E3F
***R8=4290 R9=0000 RA=FEC0 RB=F5E0 RC=884F RD=E684 RE=F874 RF=C000
***0002
***F5F8  BLWP  F4C2          F4CA  ANDI  R2, 007F
***R0=0000 R1=0088 R2=0030 R3=8845 R4=A0BA R5=7F5E R6=C000 R7=F548
***R8=E664 R9=E191 RA=FCE0 RB=EA9E RC=AAC0 RD=E664 RE=F528 RF=C000
***0001
***F4CA  ANDI  R2, 007F       F4CE  JEQ   F4E4
***R0=0000 R1=0088 R2=0030 R3=8845 R4=A0BA R5=7F5E R6=C000 R7=F548
***R8=E664 R9=E191 RA=FCE0 RB=EA9E RC=AAC0 RD=E664 RE=F518 RF=C000
***?
```

Because of the volume of printed output resulting from the full single step, it is usually reserved for use after the problem has been tightly localized.

If the quick trace is sufficient for data presented, but the subroutine calls are also desired to be traced, the standard quick trace can be used instead:

```
***? 5T
***0005  F4CE  JEQ   F4E4
***0004  F4D0  BL  F48C                   F48C=C260
***0003  F48C  MOV   E11C, R9             E11C=E185
***0002  F490  COC   FFB8, R9             FFB8=0001
***0001  F494  JNE   F48C                 RE=F528
```

The problem is detected to be in the use of the least significant portion of the multiplicand. He therefore decides to edit the program. Reviewing the listing again:

```
***? 100,11L
***0100  LWPI  0040
***0104  BLWP  F4FE
***0108  SZCB  R8, *R1
***010A  SZC   *R3, 2049(R5)
***010E  SZCB  4120, RC
***0112  SZCB  R5, *R1
***0114  SZCB  *R4, R0
***0116  WRD 0000
***0118  LI  R3, 0008
***011C  LI  R1, 0123
***0120  MPY   R1, R1
***0122  MOV   R2, R0
***0124  BLWP  F606
***0128  MOV   R2, R1
***012A  DEC   R3
***012C  JNE   0120
***012E  B   F000
***?
```

Using ASM99, addresses 122 and 128 will be modified:

```
***? 122,<ALT MODE>
***0122  A-MOV R1,R0
***0124  A-
***0126  A-
***0128  A-MOV R1,R1
***012A  A-<ALT MODE>
***?
```

Note that successive carriage returns allowed skipping over the good code to easily reach the second change area. The 'MOV R1,R1' is obviously a 'NOP' and could have been replaced by a 'WORD 0' or any other non-operation. The changed program can be listed to verify the changes:

```
***? 100,11L
***0100  LWPI  0040
***0104  BLWP  F4FE
***0108  SZCB  R8, *R1
***010A  SZC   *R3, 2049(R5)
***010E  SZCB  4120, RC
***0112  SZCB  R5, *R1
***0114  SZCB  *R4, R0
***0116  WRD 0000
***0118  LI    R3, 0008
***011C  LI    R1, 0123
***0120  MPY   R1, R1
***0122  MOV   R1, R0
***0124  BLWP  F606
***0128  MOV   R1, R1
***012A  DEC   R3
***012C  JNE   0120
***012E  B     F000
***?
```

The interrupt is turned off by setting to any odd value:

```
***? 1I
***?
```

And the program is rerun:

```
***? 100-GTHIS IS A TEST15698E95
```

This set of numbers is acceptable for our purposes (though not a good statistical distribution). We need to know how fast it executes, now. Since the routine would generally be called as a subroutine, the timing of the output drivers is of no interest; therefore, the timing software is first turned on:

```
***? V
***?
```

Since we want to know the time to generate the full set of eight numbers, a **NO**-PASS can be set at the return instruction:

```
***? 12EN
***?
```

A huge number of instructions is then requested, knowing that it will terminate when address $12E is reached:

```
***? 118-FFFJ
***0FFF  000C  0003  0118  LI   R3, 0008       R2=0030 R3=0008 R6=C000
***          R7=F548  R9=E181  RD=E664  RE=F528  RF=C400
***0FFE  0018  0006  011C  LI   R1, 0123            R1=0123  R6=C000
***0FFD  002E  000C  0120  MPY   R1, R1             R1=0001
***0FFC  003C  0010  0122  MOV   R1, R0             RE=F528
***SB- 0124  BLWP  F6060
***0FFB  0044  0014
***0128  MOV   R2, R1       012A  DEC   R3
***R0=0000 R1=0030 R2=0030 R3=0008 R4=A0BA R5=7F5E R6=0400 R7=F548
***R8=E664 R9=E181 RA=FCED RB=EA9E RC=AACD RD=E664 RE=F528 RF=C400
***0FFA  0056  0017  012A  DEC   R3           R3=0007 R6=0000 RF=C000
***0FF9  0060  0018  012C  JNE   0120               RE=F528
***0FF8  0076  001E  0120  MPY   R1, R1             R1=0000  RF=C400
***0FF7  0084  0022  0122  MOV   R1, R0             RE=F528
***SB- 0124  BLWP  F6060
***0FF6  0092  0026
***0128  MOV   R2, R1       012A  DEC   R3
***R0=0000 R1=0030 R2=0030 R3=0007 R4=A0BA R5=7F5E R6=0400 R7=F548
***R8=E664 R9=E181 RA=FCED RB=EA9E RC=AACD RD=E664 RE=F528 RF=C40C
***0FF5  009E  0029  012A  DEC   R3           R3=0006 R6=0000 RF=C000
***0FF4  00A8  002A  012C  JNE   0120               RE=F528
***0FF3  00BE  0030  0120  MPY   R1, R1             R1=0000  RF=C400
***0FF2  00CC  0034  0122  MOV   R1, R0             RE=F528
***SB- 0124  BLWP  F6060
***0FF1  00DA  0038
***0128  MOV   R2, R1       012A  DEC   R3
***R0=0000 R1=0030 R2=0030 R3=0006 R4=A0BA R5=7F5E R6=0400 R7=F548
***R8=E664 R9=E181 RA=FCED RB=EA9E RC=AACD RD=E664 RE=F528 RF=C400
***0FF0  00E6  003B  012A  DEC   R3           R3=0005 R6=0000 RF=C000
***0FEF  00F0  003C  012C  JNE   0120               RE=F528
***0FEE  0106  0042  0120  MPY   R1, R1             R1=0000  RF=C400
***0FED  0114  0046  0122  MOV   R1, R0             RE=F528
***SB- 0124  BLWP  F6060
***0FEC  0122  004A
***0128  MOV   R2, R1       012A  DEC   R3
***R0=0000 R1=0030 R2=0030 R3=0005 R4=A0BA R5=7F5E R6=0400 R7=F548
***R8=E664 R9=E181 RA=FCED RB=EA9E RC=AACD RD=E664 RE=F528 RF=C400
***0FEB  012E  004D  012A  DEC   R3           R3=0004 R6=0000 RF=C800
***0FEA  0138  004E  012C  JNE   0120               RE=F528
***0FE9  014E  0054  0120  MPY   R1, R1             R1=0000  RF=C400
***0FE8  015C  0058  0122  MOV   R1, R0             RE=F528
***SB- 0124  BLWP  F6060
***0FE7  016A  005C
***0128  MOV   R2, R1       012A  DEC   R3
***R0=0000 R1=0030 R2=0030 R3=0004 R4=A0BA R5=7F5E R6=0400 R7=F548
***R8=E664 R9=E181 RA=FCED RB=EA9E RC=AACD RD=E664 RE=F528 RF=C400
***0FE6  0176  005F  012A  DEC   R3           R3=0003 R6=0000 RF=C000
***0FE5  0180  0060  012C  JNE   0120               RE=F528
***0FE4  0196  0066  0120  MPY   R1, R1             R1=0000  RF=C400
***0FE3  01A4  006A  0122  MOV   R1, R0             RE=F528
***SB- 0124  BLWP  F6060
***0FE2  01B2  006E
***0128  MOV   R2, R1       012A  DEC   R3
***R0=0000 R1=0030 R2=0030 R3=0003 R4=A0BA R5=7F5E R6=0400 R7=F548
***R8=E664 R9=E181 RA=FCED RB=EA9E RC=AACD RD=E664 RE=F528 RF=C400
***0FE1  01BE  0071  012A  DEC   R3           R3=0002 R6=0000 RF=C000
***0FE0  01C8  0072  012C  JNE   0120               RE=F528
***0FDF  01DE  0078  0120  MPY   R1, R1             R1=0000  RF=C400
***0FDE  01EC  007C  0122  MOV   R1, R0             RE=F528
***SB- 0124  BLWP  F6060
***0FDD  01FA  0080
***0128  MOV   R2, R1       012A  DEC   R3
***R0=0000 R1=0030 R2=0030 R3=0002 R4=A0BA R5=7F5E R6=0400 R7=F548
***R8=E664 R9=E181 RA=FCED RB=EA9E RC=AACD RD=E664 RE=F528 RF=C400
***0FDC  0206  0083  012A  DEC   R3           R3=0001 R6=0000 RF=C000
***0FDB  0210  0084  012C  JNE   0120               RE=F528
***0FDA  0226  008A  0120  MPY   R1, R1             R1=0000  RF=C400
***0FD9  0234  008E  0122  MOV   R1, R0             RE=F528
***SB- 0124  BLWP  F6060
***0FD8  0242  0092
***0128  MOV   R2, R1       012A  DEC   R3
***R0=0000 R1=0030 R2=0030 R3=0001 R4=A0BA R5=7F5E R6=0400 R7=F548
***R8=E664 R9=E181 RA=FCED RB=EA9E RC=AACD RD=E664 RE=F528 RF=C400
***0FD7  024E  0095  012A  DEC   R3           R3=0000 R6=0000 RF=C000
***0FD6  0258  0096  012C  JNE   0120               RE=F528
***0FD5  026C  009A  012E  B    F000             F00C=1054  RF=C000
***<BELL>?
```

With the **V**erify timing software active, the following information is printed:

Col. 1	#instructions yet to do
Col. 2	#clock cycles since start (HEX)
Col. 3	#memory accesses since start (HEX)
Remainder	same as without **V** for given trace (S, T or J)

The elapsed time can therefore be read at any desired instruction. Turning off the **V**erify will convert these to decimal for you:

```
***? V
***  DECIMAL CLOCK CYCLES =  600     DECIMAL MEMORY ACCESSES =  100
***?
```

If interested in the number of instructions traced, subtract the original number requested from the last number. Thus:

```
***? FFF,FD5=1FD4  0100  002A  40
***?
```

$2A instructions were traced, which is also shown to be decimal 40.

The program took $30 bytes to write. If it is desired to know this number in decimal, the **$** command is used:

```
***? 30$HEX=48  DECIMAL, OR  0030 DECIMAL=001E HEX
***?
```

The final user status on return can also be easily examined:

```
***? P
***I=012E   PC=F000   WP=E6E4   ST=3002
***012E  B   F000        F000  JMP   F0AA
***R0=0000 R1=0030 R2=0030 R3=0000 R4=A0BA R5=7F5E R6=C003 R7=F548
***R8=E664 R9=E181 RA=FCED RB=EA9E RC=AACD RD=E664 RE=F528 RF=C003
***?
```

Memory testing, done via:

```
***? 100,1000:M
```

Leaves the last walking one pattern in RAM when terminated:

```
***? 100,400
***0100  1000 0800 0400 0200 0100 0080 0040 0020    ..............._A.
***0110  0010 0008 0004 0002 0001 8000 4000 2000    ............._A. .
***0120  1000 0800 0400 0200 0100 0080 0040 0020    ..............._A.
***0130  0010 0008 0004 0002 0001 8000 4000 2000    ............._A. .
***0140  1000 0800 0400 0200 0100 0080 0040 0020    ..............._A.
***0150  0010 0008 0004 0002 0001 8000 4000 2000    ............._A. .
***0160  1000 0800 0400 0200 0100 0080 0040 0020    ..............._A.
***0170  0010 0008 0004 0002 0001 8000 4000 2000    ............._A. .
***?
```

Selected blocks can be set to any desired data value as:

```
***? 100,11E:1234Z
***? 100,400
***0100  1234 1234 1234 1234 1234 1234 1234 1234    .4.4.4.4.4.4.4.4
***0110  1234 1234 1234 1234 1234 1234 1234 1234    .4.4.4.4.4.4.4.4
***0120  1000 0800 0400 0200 0100 0080 0040 0020    ..............._A.
***0130  0010 0008 0004 0002 0001 8000 4000 2000    ............._A. .
***0140  1000 0800 0400 0200 0100 0080 0040 0020    ..............._A.
***0150  0010 0008 0004 0002 0001 8000 4000 2000    ............._A. .
***0160  1000 0800 0400 0200 0100 0080 0040 0020    ..............._A.
***0170  0010 0008 0004 0002 0001 8000 4000 2000    ............._A. .
***?
```

The session is over, so the UPLOAD gets turned off, too:

```
***? U
***
***EXIT TEXT MODE
***PACK,A1
***
***>REPLACE,A1
***
***>FULL
***>
***?
```

COMMAND SUMMARY

<HEX>,	Set memory search pointer starting address (**MSA**) to <HEX>
<HEX>;	Set memory search pointer ending address (**MEA**) to <HEX>
<HEX>-	Set user transfer address (**UTA**) to <HEX<
/	Transfer to KRONOS control (same as K)
<HEX>'	(Apostrophe) insert HEX value <HEX> in memory location MSA and increment MSA by two.
<HEX>=	Print sum, then difference, of MSA and <HEX> in both hexadecimal and decimal formats.
<ALT MODE>	Transfer from command mode to ASM mode. Transfer from ASM mode to command mode. Transfer from KRONOS mode to command mode. KRONOS = => DDT99 DDT99 = => ASM ASM = => DDT99
<BS>	Delete previous character (only works **back to last valid command**) same as <**CONTROL-H**>

<CR>	Delete entire line (**back to last valid command**)
<CONTROL-H>	Delete previous character (only words **back to last valid command**). Same as <**BS**>.
<CONTROL-P>	**(OPT) P**unch binary paper tape from **MSA** to **MEA**.
<CONTROL-R>	**(OPT) R**ead binary paper tape as punched by <CONTROL-P> command.
<CONTROL-T>	Begin download sequence when in KRONOS mode. Automatically send by **ECHOIT.**
<CONTROL-U>	Terminate download sequence. Automatically sent by **ECHOIT.**
<HEX>**$**	Print HEX to decimal and decimal to HEX conversions.
<HEX>**G**	Transfer to UTA without changing breakpoint from last set. Pass breakpoint <HEX> times before acknowledging it.
<HEX>**H**	**(OPT)** auto-hardcopy. <HEX> = 0 = = = > turn off <HEX><>0 = = = > turn on
<HEX>**I**	Set breakpoint to <HEX> (if <HEX> is odd, turn off breakpoint)
<HEX>**J**	Trace <HEX> instructions (starting at UTA), printing only the registers that change with the instruction, and turning off the trace through execution of any BL or BLWP instructions.
K	Switch to KRONOS mode. Same as *I*.
<HEX>**L**	List by mnemonic <HEX> instructions starting at MSA. When done, set MSA pointing to next instruction after those listed.
<HEX>**M**	**(OPT) M**emory test with walking ones from MSA to MEA with <HEX> loop delay.
<HEX>**N**	**N**O PASS. Stop trace at address <HEX>
<HEX>**O**	Set user's status register
P	Print status of user program including: User program counter (PC) User workspace pointer (WP) User status word (ST) First instruction executed in last transfer to user program Next instruction to be executed if transfer requested All user registers
<HEX>**Q**	Quick dump of <HEX> memory addresses (starting at MSA) in hexadecimal and ASCII formats. MSA is left unchanged.
RK	Set user register K to MSA.
<HEX>**S**	Single step user program for <HEX> steps, starting at UTA. At termination, set UTA to next instructoin that would have been executed had stepping continued. Print every user register (as well as last instruction and next instruction) after each step is executed. After <HEX> instructions have been executed, wait for further terminal input. A <SPACE> will cause continuation for one more step (then wait again, ad infinitum) a <CR> will cause return to normal command mode.
<**RUBOUT**>	Stop execution of program and return to DDT99 V1.2 command mode. This works for either DDT99 V1.2 'runaway' commands or for user programs that have not altered interrupt 2 vectors.
<HEX>**T**	Single step user program in a manner identical to the **S** instruction, except that only the registers that changed are printed after each instruction. Note that an **S** or **P** may be typed at any time to get more complete status. A **T** then has to be retyped to return to the quick trace mode.
U	**U**PLOAD. Toggle in/out and control KRONOS text communication to make sequence as painless as possible.
<HEX>**V**	**(OPT) V**erify Timing. <HEX> = 0 = = = > toggle in/out setting clock to zero and printing decimal value on leaving <HEX><>0 = = = > do not change clock, but print decimal clock values
<HEX>**W**	Set user's **W**orkspace pointer
X	Simulate power up of DDT99 V1.2, resetting all variables to default values except the line feed delay (it is assumed you are still on the same terminal)
<HEX>**Z**	Set memory area from MSA to MEA inclusive to value <HEX>.

Next month, Part II — Listing of the monitor software.

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TRS-80 OWNER: TRS—80 Star Trek for sale. This is a complete version with 6 commands. Also included is a Computer Art program free, $10 with cassette and complete instructions. Lunar Lander with full graphics. Prints ship status, Lander and lunar surface all in graphics, $7.50 with cassette and full instructions with list of different modifications. Also have other programs upgraded to run in graphics. All for Level 1, 4K Machine. For catalog send SASE to: Sandy Sigal, 6851 Mammoth Ave., Van Nuys, CA 91405, (213) 989-5488.

FOR SALE: SOL-20 dealer demo unit, $1200. D. Linn or S. Koenig, 8406 E. Harry, #712, Wichita, KS 67207, (316) 685-5959.

FOR SALE: Altair 8800A, two PT 4 KRO, one 8K Vector Graphic 3P&S, PT 2KRO, MITS ACR, all assembled and working. Includes MITS 4, 8, & 12K BASIC on paper tape and Radio Shack cassette tape recorder. First cashier's check for $1200 takes it. John Hunt, 1 Kelton Court, #4E, Oakland, CA 94611, (415) 652-6408 Home, (415) 398-0289 Work.

TRS-80 OWNERS: I am interested in securing any program for insurance rating that will run on the TRS-80. Particularly interested in auto rating for comparative purposes. Please write Oscar Boxer, 8383 Wilshire Blvd., Suite 228, Beverly Hills, CA 90211.

FOR SALE: Motorola Educator II microcomputer. Already assembled. 256 bytes RAM. Edge connector with cassette and power wires attached. Selling as is, $125. Ewing, 7481 Lee Hwy., #211, Falls Church, VA 22042, (703) 560-6899.

CASINO BLACKJACK: For Texas Instruments Programmable 59. Most complete version available for handheld unit. Allows up to 6 players to bet, hit, stand, double down, insure, and split pairs against the house. Keeps score and displays all cards automatically. Cost is only $3.50 and includes program listing and quality documentation. Send 2 mag cards and will record this 600 + step program for you as well. Robert Griffin Jr., 104 Briar Rd., Nanuet, NY 10954.

FOR SALE: TRS-80 Level-1 tapes and program lists. Star Trek (runs on 12K), list $7.00, tape $10.00; Lunar Lander (runs on 4K), list $3.00, tape $6.00; Biorhythm (runs on 4K), list $5.00, Tape $9.00. J.R. Menzies, 7106 Colgate Dr., Alexandria, VA 22307.

WANTED: Software on cassettes compatible with TDL super BASIC or Meca Microsoft Ext. BASIC, as hardly any is available in Holland. We are willing to buy all sorts, business, games, etc. Jan Boers, P.O. Box 135, 9300 AC Roden, Holland.

TIRED of your PET's hard-to-use keyboard and program bugs? Want a self-erasing program or "invisible program" or even special control characters for your HP9830? If so, contact J. Milton and N. Novotney with your program specs. We will design and debug the right program for you and ship it via cassette tape to you at a low, low price. Try it! Norm Novotney, 3845 Lynward Rd., Columbus, OH 43228, (614) 274-2145.

FOR SALE: North Star software special. Personal finance and budgeting package: $15.00; Memory test: $10.00, diskopy: $10.00, both for $15.00. Stock Market analysis package: $10.00; Correspondence editor, $5.00; Mai list: $5.00. Special assortment disc $10.00. Plus much more. Send blank disc or $5.25 for disc. Write for complete list. Herb Schildt, 1007 N. Division, Urbana, IL 61801.

COUNTRYWIDE TRS-80 User Group Software Exchange: scientific, business, entertainment, specific use, electric books, graphic games, trig-interrogator, user group mail list. Send: info; configuration, application, interests, your collection of programs, with "byline"; on cassette, to be returned with our software, and small donation for our volunteer copy boy, a SASE or mailer. Numerical Integration West, Attn: John McGortey/Stuart Nims, 10409 State St., South Gate, CA 90280, (213) 566-8035.

WANTED: SWTPC 6800 system. 8K or more memory and serial I/O. Call or send information to Dan Stirling, 1607 S. 235 Pl. #I-8, Kent, WA 98031, (206) 878-2608.

WANTED: Floppy disk drives (any condition), line printer (100 + cps), OSI boards, S-100 boards, 6502 hardware and software, C-MOD (MMM/Celetron) boards and software. I.R. Peterson, 669-23 Ave. N.W., St. Paul, MN 55112, (612) 633-1599.

FOR SALE: Centronics 101A with lower case option, parallel input, switch or software for double width characters. Includes stand and paper tray, $1200. You pay freight. Digital Group 8K memory boards 400ns low power. Two at $200 each, I pay shipping. D. L. Earle, 729 Milam Bldg., San Antonio, TX 78205, (512) 222-0077 or 690-0499.

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MUST SELL: 3P+S Processor Technology I/O card. 2 parallel I/O's and 1 serial I/O. $100 A&T. Oliver Audio OP-80A paper tape reader. Used only a few times. $50.00 A&T. Cassette Interface from Percom Electronics. Only needs serial or parallel I/O and cassette recorder/player. Baud selectable from 300 to 1200 baud. A&T, $50.00. PROM board from Godbout. Holds 8K 5204 and has the Godbout monitor. $75 takes assembled board and PROMs. For more info contact Larry Belmontes Jr., 1762 Yale St., Corpus Christi, TX 78416, (512) 855-2687, or 854-2662.

FOR SALE: North Star Horizon I assembled and tested. Never used. In factory box with factory warranty. $1788 + shipping. J.D. Peab, 536 Center Ave., Pittsburgh, PA 15147, (412) 793-7526.

TRS-80 OWNERS: For Sale: Computer Art Program. Very complete with 5 options plus list of 4 other art options. Listing cost $3, Tape cost $7. Also have Star Trek, Othello, Biorhythm, Mastermind, other games and demonstration package. Write SASE for catalog. All programs written for 4K Level 1 Machine. Sandy Sigal, 6851 Mammoth Ave., Van Nuys, CA 91405.

FOR SALE: Programs for your PET 2001 8K Basic Computer. Star Wars, Hangman, Mind Teaser, Battle Ship, Horse Race and a few others. The price is $5.00 for Star Wars, and $3.00 each for the others. Send tape or add $2.00. Send for booklet to be sure that you want it! $1.00 for Xerox copy. 400 28th St., Sacramento, CA 95816, (916) 447-0113.

FOR SALE: Model ASR 33 Teletype, excellent condition, w/paper tape & stand, $850. TI 960 minicomputer w/8Kx16 RAM and Battery Backup/CRU Bus controller and 20ma serial interface cards, $3500. MITS 8080 CPU card, $75. 3 MITS 4K dynamic memory boards, $125 each. Contact Loren English, (213) 838-7355.

FOR SALE: Disk file access software for North Star Disk. By calling routines within this package, a program is given multiple file I/O at the byte level. Entry points allow file to be opened, closed, read, written, created or released. Requires less than 2K in addition to North Star DOS. Send $10.00 for commented source listing to Bob Burlingame, 1117 N. Hawthorne, Tacoma, WA 98406.

FOR SALE: Complete PolyMorphic system. Includes CPU board, 2 8K boards, video board, 5-slot motherboard, Panasonic tape recorder, keyboard, converted TV, all cables and assorted pre-recorded software. All less than 9 months old. Preassembled. Best offer over $1750. Scott Hayden, 23921 Colfax St., Lowell, IN 46356, (219) 552-0232.

FOR SALE: two MITS 4K dynamic memory boards, factory assembled and operational, $75 for each or $125 for both; also a complete micro system, Altair 8800A, ASR 33 with MITS SIOC interface, North Star micro disk and controller, DOS BASIC and several diskettes, 2 16K Dynabyte dynamic memory boards, all 100% operational for $3100. John Teets, 1600 Shirland Tract, Auburn, CA 95603, (916) 885-9456.

FOR SALE: Altair 8800 w/16-slot motherboard plus 16-edge connectors, cooling fan mod., 2SIO-serial I/O w/both ports, 88-PIO parallel I/O board, 1K static memory w/512-bytes of memory, 12K static memory, 4K PROM software board with 8080 assembler, text editor, and system monitor, and all documentation. All A&T, $1500 + you pay shipping. Call or write Don Cheeseman, 8231 Creekline Dr., San Antonio, TX 78251, (512) 681-4938.

CHALLENGER IIP user would like to swap software, applications, etc., with other IIP owners. If there is enough interest, I would put out a monthly newsletter. Let me know your thoughts. Neil Shapiro, 32-20 91 St., Apt. 607, Jackson Heights, N.Y. 11369.

FOR SALE: Alpha Micro Computer—new never used Time sharing, multi-tasking system. Imsai 8080 mainframe, 4 Soroc CRTs, TI 810 printer, Sanyo monitor, IMS dual floppy driver, TI Silent 700 and Ventel Modem, Dysan Diskettes. Complete manuals and documentation. Best offer. Write or call Jason Semerad, 4759 Hollywood Blvd., Los Angeles, CA 90027, (213) 666-8505.

FOR SALE: TDL Xitan with ZPU, system monitor board, video display board, 34K, 250ns memory, George Risk keyboard, 12" CRT-TV, 12K BASIC, Macro Assembler, Text Editor, Text Processor. All assembled and running for $2095. Jon A. Batcheller, P.O. Box 13898, Gainesville, FL 32603, (904) 373-7004.

FOR SALE: Computer Automation LS12-10G 16-bit minicomputer, 16K core memory, I/O distributor, 4 general purpose byte parallel pico-processor, 1 card reader pico-processor, programmers, console, 5 slot chassis and power supply. Manuals and paper tape assembly language software included. Excellent condition. $3750.00. J. Jenson, 24962 Stagecoach, Laguna Hills, CA 92653, (714) 768-9265.

WANTED: RPG Compiler. Anyone writing an RPG II compiler for micros or planning to do so. Please write or call me: Dennis Fletcher, INFO 3, 21241 Ventura Blvd., #193, Woodland Hills, CA 91364, (213) 999-5753; (800) 423-5205 outside of California only.

WANTED: Tractor feed printer, TRS-80. Mike Garey, P.O. Box 561074, Miami, FL 33156.

WANTED: 8080 Assembler source listing for Intel MDS/Intellec 8. Interested in comments and structure, so can be any version in 8080 mnemonics or PLM. Contact Dave Gillespie, 1331 N. Lotta Dr., Los Angeles, CA 90063.

FOR SALE: Workbook for the Commodore PET 2001. If you need more information to use your PET, send $4 for booklet "Getting Started with Your PET," to Dave Schultz, Box 921, Los Alamos, NM 87544.

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